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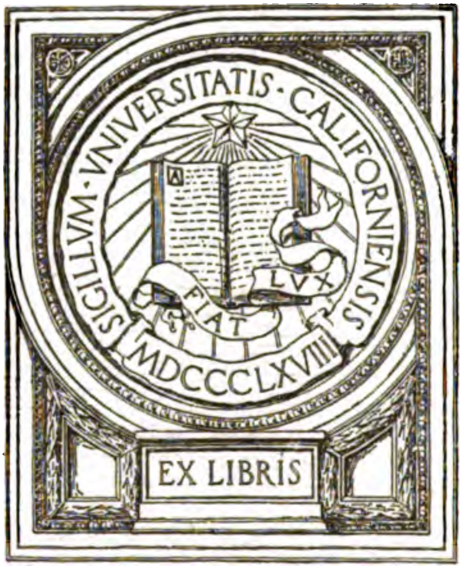

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FOREWORD

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THE EDITOR

Rochester, Minnesota,
July, 1911.

311385

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ALIMENTARY CANAL

MIXED TUMORS OF THE PAROTID GLANDS

By EDWARD STARR JUDD

It has long been known that tumors of the salivary glands possess, as a rule, a peculiar morphology which differs from that of tumors found in almost any other organ.

By far the greater number of tumors in the salivary glands are the so-called "mixed tumors." These tumors are much more frequently found in the parotid than in the other salivary glands. The new-growths contain a considerable variety of tissues, generally regarded as of mesoblastic origin, such as cartilage, myxomatous tissue, fat and lymphoid structures; while the parenchyma cells proper resemble, morphologically, either connective-tissue cells, in which case the tumors are considered as sarcomata, or endothelial cells, in which case the growths are classed as endotheliomata.

Because of the great variety of tissues which may be found in any of these tumors, it is difficult to make a classification. The following classification by Hanseman is one of the simplest and best:

1. Endothelial carcinoma.
2. Endothelial sarcoma.
3. Endothelial carcinoma-sarcoma.
4. Endothelial tumors with development of special tissues.
5. Endothelial adenoma.*

Classified in this manner, all of the tumors are considered endotheliomata, with the predominating epithelial or connective-tissue cells as the index. It is seldom satisfactory to name one of these tumors and to try to indicate each tissue in the name. His originated the term "endothelium" in 1865. Since then there has been a great deal of discussion among embryologists as to the derivation of endothelium; whether it is mesoblastic or hypoblastic, and also just which is endothelium and which is epithelium. Volkmann is conceded to be the chief exponent of the endothelial theory in regard to these "mixed tumors." He regards them as endotheliomata, believing that, as the result of metaplasia, the stroma may become converted into tissues of different type, and that the columns of cells and gland-like tubules are formed by the proliferation of the endothelium lining the tissue spaces and lymph-vessels. Hinsberg, Wilms, and Ribbert dispute this theory, believing that these tumors develop from displaced glandular germinal tissue, the stroma of which, because of the close relationship of the branchial arches, is capable of forming bone and cartilage. Wilms believes that these tumors develop from embryonal rests, consisting of epithelium and mesenchyme, which have remained latent for a long time.

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* The pathologic department of St. Mary's Hospital is at present engaged in an exhaustive study of these tumors with a view to their analysis and re-classification.

In a description of endothelial tumors Volkmann says: "The characteristic morphologic peculiarities of these tumors lie in the arrangement of the tumor cells in strands and tubules, which distinguishes the growths from the sarcomata, and gives them a close resemblance to carcinomata. The cells of the tumor are often in very close relationship with the connective tissue of the spaces in which the cells lie, as is evidenced by the fact that cells remain attached to the walls of the space and do not retract when the tumor is hardened in fixing fluids, as is usual in carcinoma. The cells of the endothelial tumors line the walls of the tissue spaces without the intervention of layers of normal endothelial cells, such as is seen in carcinoma when metastases extend along lymph-spaces. The cartilage of the endothelial tumor arises from a fibrous connective-tissue stroma by softening of the intercellular substance, and the production is a myxomatous tissue which later develops cartilage and a homogeneous intercellular tissue. Cell masses of endothelial nature may also develop from the cartilaginous or myxomatous areas, and in many cases the spindle cells of the connective-tissue stroma may be regarded as genetically equivalent to the endothelial cells of the solid strands and tubules."

French observers have been inclined to class these tumors, when malignant, as "carcinomata," the less malignant as "adenomata," and, if the growth contains cartilage or bone-cells, as "mixed tumors." The mixed tumors differ from carcinomata in that there is no connection between the glandular structures; they are completely inclosed in a thick capsule and oftentimes lie at some little distance from the gland substance.

Frequency of Occurrence.—These neoplasms occur ten or eleven times in the parotid gland to once in the submaxillary gland; they very seldom occur in the sublingual. We have seen forty-one of these tumors in the parotid and four in the submaxillary gland, but none at all in the sublingual gland.

General Morphology.—There is no uniformity as regards either the nature or the origin of these tumors. They are generally encapsulated in a dense fibrous capsule, lobular, very fibrous, and very hard. One-fourth of all the tumors in the cases reported contain cartilage. The firmness and hardness are probably due to the density of the tissue in the tumor, or to the extreme tension of the fibrous capsule; *e. g.*, when the tumor reaches considerable size and the skin is drawn tightly over it. If the growth is less hard, it is usually an indication that it is highly cellular and probably very malignant.

In twenty-two of our forty-one cases the tumors were in the right parotid glands. Twenty-five of the patients were females.

Time of Occurrence.—The majority of these tumors occurred in the second decade. The youngest patient in our series was fifteen years of age, and the oldest seventy-one years of age.

15 to 20 years of age	5 cases
21 to 31 " "	7 "
31 to 40 " "	12 "
41 to 50 " "	9 "
51 to 60 " "	4 "
61 to 71 " "	4 "

Average length of time in which the patient had the trouble before operation, eight years. A number of cases have been reported in which the tumor had been practically dormant for over fifty years. In our series one case appeared to be of one month's duration.

Cases	with	symptoms	under	1 year	6
"	"	"	"	3 years	3
"	"	"	"	6 years	8
"	"	"	"	10 years	5
"	"	"	"	20 years	2
"	"	"	"	30 years	2

Relation of Tumors to the Surrounding Structures.—These tumors may lie well encapsulated within the substance of the parotid gland. In some cases the capsule will not be very distinct, and the growth will infiltrate into the salivary gland. Usually there is but one tumor, though they may be multiple and scattered throughout the substance of the gland. The encapsulated tumor may lie at some distance from the gland and not be attached to it in any way, even by a pedicle of fibrous tissue.

Clinical Course.—In articles written by Francis Carter Wood,* it is estimated that 25 per cent. of these tumors change to a malignant course, and that 30 per cent. recur after operations. Four of his series of thirty-seven cases had internal metastasis or bone invasion by extension. Wood advises operation even in the recurring cases; he says that frequently a thorough secondary operation will cure the patient.

One of these mixed tumors may grow slowly for a time, and then remain stationary for from twenty to thirty years, giving no special symptoms; then a sudden change may occur, the tumor will become rapidly malignant, and destroy the life of an individual in a very short time, or from the start the tumor may grow rapidly malignant and destroy life within a few months. Microscopically the structure of both varieties of tumors will be similar.

In the early part of their course these tumors will produce but few symptoms, which accounts for the length of time between the beginning of the trouble and the time when the patient seeks treatment. The fact that they remain dormant and of a certain size for a great many years, and then suddenly and rapidly increase their growth, would indicate the sudden giving way of the capsule of the tumor at some point, thus allowing the growth to extend. It is well known that if in operating we only partially remove these tumors,—in other words, if we open these capsules and leave some of the cells behind,—these cells will multiply and grow much more rapidly than they were doing before the interference. In this connection it is interesting to note that if we remove these tumors while they are inactive, it will frequently be difficult to find evidences of malignancy; on the other hand, if the growth recurs, or if we remove a metastasis growth, the recurrence of metastasis is almost always the sarcomatous element. There may be no symptoms in these cases except the presence of the tumor, although in the later stages there may be symptoms of facial paralysis from pressure on the facial nerve, and partial deafness due to a narrowing of the auditory canal.

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* "Annals of Surgery," Jan. and Feb., 1904.

Diagnosis.—The diagnosis is based on the position of the tumor, the slow growth, its nodular form, uneven consistency, and encapsulation. A mixed tumor rapidly becoming malignant may be differentiated from sarcoma or carcinoma before its removal, only by the history. If the tumor is small, we must differentiate from a tuberculous lymph-node, lipoma, or retention cyst. Microscopically the neoplasm is characteristic; *i. e.*, lobulated, mottled, soft, hard, solid, and cystic areas intermingled.

We have operated upon forty-one cases of mixed true tumors of the parotid. In nine of these cases the endothelial element predominated, five were sarcomatous, three were mixed-cell tumors undergoing sarcomatous change, and three were mixed tumors undergoing endotheliomatous change. Ten of these patients came to us with recurring growths, or they had recurrences following our operations.

Twenty-seven of the forty-one patients have recently been heard from: twenty-four of them state that they are perfectly well, and three of them say they have a local recurrence. Two of the three had predominating sarcomatous elements at the time of operation. One, a man seventy years of age, had had a tumor for thirty years, with a history of rapid growth during the last three months. This patient died, evidently of metastasis.

The endeavor to preserve all of the fibers of the seventh nerve may be said to be the cause of most of the recurrences following the removal of mixed tumors of the parotid gland. If we could deliberately excise the tumor, with as much of the parotid as we deem wise, there would be no recurrences in the early cases; but as long as these tumors are not severely malignant in the beginning, whether we are justified in sacrificing the facial nerve is a grave question.

In the encapsulated cases it has been our custom to excise the tumor completely with the capsule, and to pack the entire wound with gauze saturated with a caustic (Harrington's solution), in order that the raw surfaces may be seared to prevent the grafting of any cells. We have not found it necessary to remove any of the lymphatics if the growth is well encapsulated, and we have not observed that these tumors involve the lymphatics until very late in their development. On the other hand, if the disease is extending into the parotid and into the surrounding lymphatics, we have excised the parotid entirely, and with it the adjoining lymphatics. In these cases we disregard the facial nerve. In a few of our cases the tumors were very large, pressing into the mouth and throat, and causing considerable dysphagia and interference in swallowing. In these cases, in addition to the removal of the parotid gland, it was necessary to sacrifice the external carotid artery and the internal jugular vein.

THE TECHNIC OF THE EXAMINATION OF ESOPHAGEAL LESIONS*

By H. S. PLUMMER

About 300 esophageal cases which have come under observation during the last four years have been studied not only with a view to the establishment of a correct diagnosis and productive therapeutics for the individual case, but also with the idea of determining the relative value of the clinical and technical findings. I wish in this paper to consider briefly those points which contribute to obtaining definite technical data safely.

The clinical examination is of the utmost importance not only for its intrinsic value, but as a guide to the succeeding technical procedures. The more important features to be determined in esophageal diseases by the technical methods of examination are the existence, size, and relations of pockets, dilatations, and strictures, and the character of the esophageal wall, notably at the seat of narrowing.

The technical methods which have proved of especial value may be grouped under three heads: namely, roentgenography, esophagoscopy, and the various methods of sounding.

Roentgenography discloses thoracic masses obstructing the esophagus by pressure from without, and occasionally a good shadow may be obtained of an esophageal tumor. Its chief service is that of revealing the position, shape, size, and relations of diverticula and dilatations when filled with bismuth mixtures. Diverticula, as a rule, give shadows which are characteristic

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* Read in the Section on Surgery of the American Medical Association, at the Sixty-first Annual Session, at St. Louis, June, 1910. (Reprinted from Transactions of the Section on Surgery, Am. Med. Assoc., 1910.)

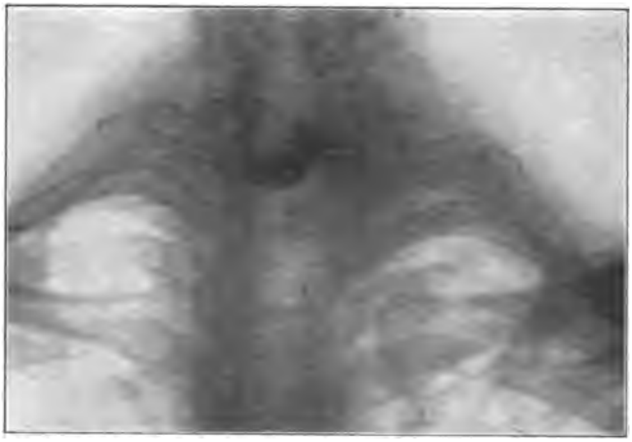

Fig. 1.—Diverticulum of esophagus, from skiagraph.

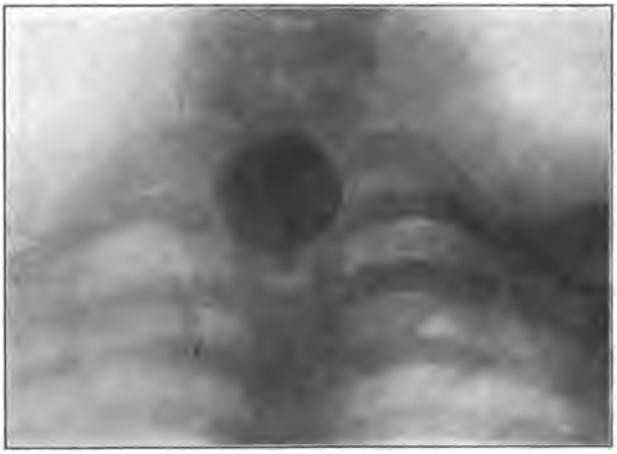

Fig. 2.—Diverticulum of esophagus, from skiagraph.

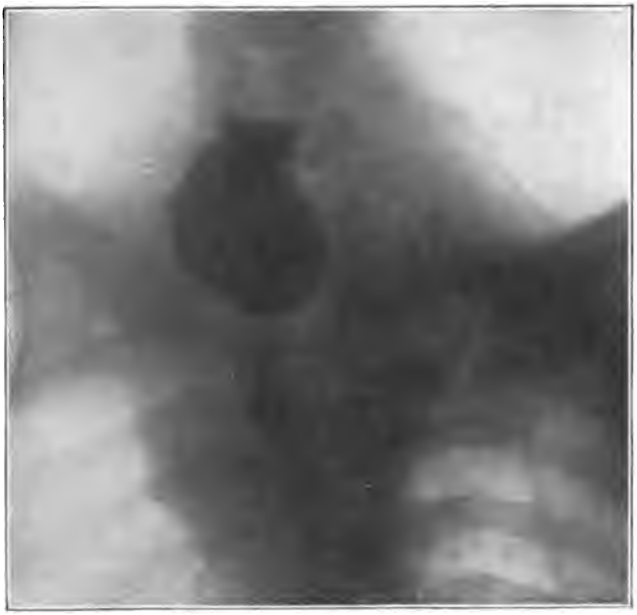

Fig. 3.—Diverticulum of esophagus, from skiagraph.

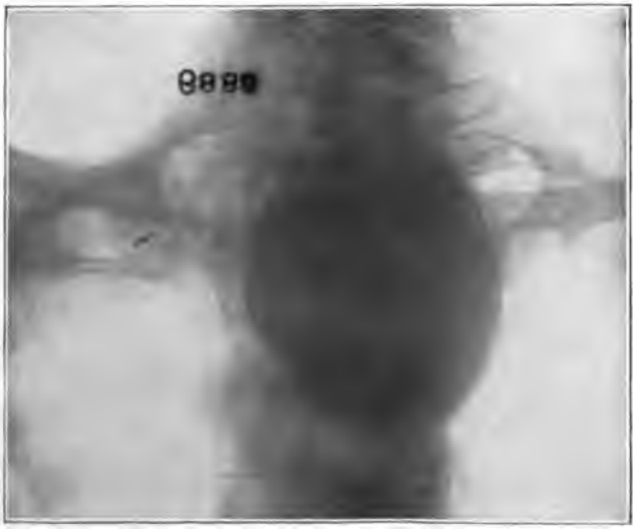

Fig. 4.—Diverticulum of esophagus, from skiagraph.

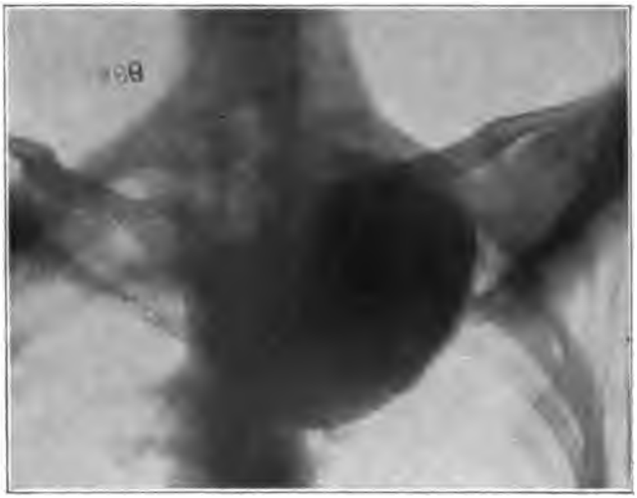

Fig. 5.—Diverticulum of esophagus, from skiagraph.

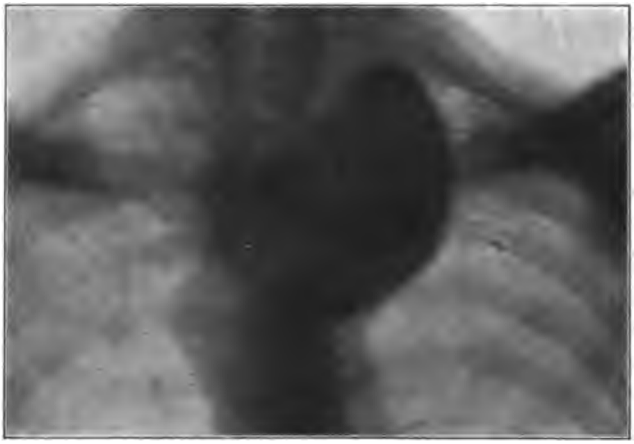

Fig. 6.—Diverticulum of esophagus, from skiagraph.

(Figs. 1 to 6). The large dilatations which occur in the upper third of the esophagus above organic strictures can be distinguished from diverticula by a tail-like portion of bismuth extending downward from the bottom of the sac (Fig. 7). However, this may be absent. Passing a small sound on a thread quickly differentiates the two conditions. Most striking are the large, irregularly spindle-shaped shadows obtained in cases of diffuse dilatation of the esophagus following spasmodic and, infrequently, organic stricture at the cardia.

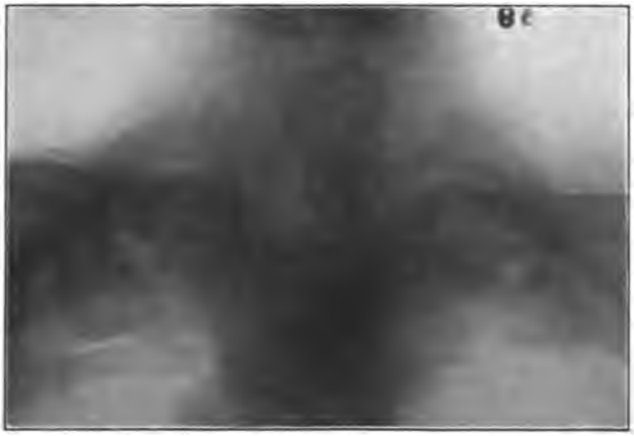

Fig. 7.—Large dilatation in upper part of esophagus, above organic stricture.

In cases of cardiospasm (Figs. 8 to 19) the lower extremity of the shadow is cone-shaped and its apex corresponds (Fig. 20) to the hiatus œsophagi, while in cases of organic stricture the outline is irregular and terminates above the hiatus. In most instances the dilatation extends to the upper border of the manubrium and is constricted at the root of the lung. The dilatations occurring above organic strictures are, as a rule, of limited extent and in their lower portion irregular in outline (Fig. 21).

While the fluoroscopic pictures are interesting in studying both the normal and pathologic processes of deglutition, they add but little to the plate method in esophageal diagnosis. Mucilage of acacia has proved the most valuable vehicle in which to give bismuth. It adheres to the esophageal wall and can be readily

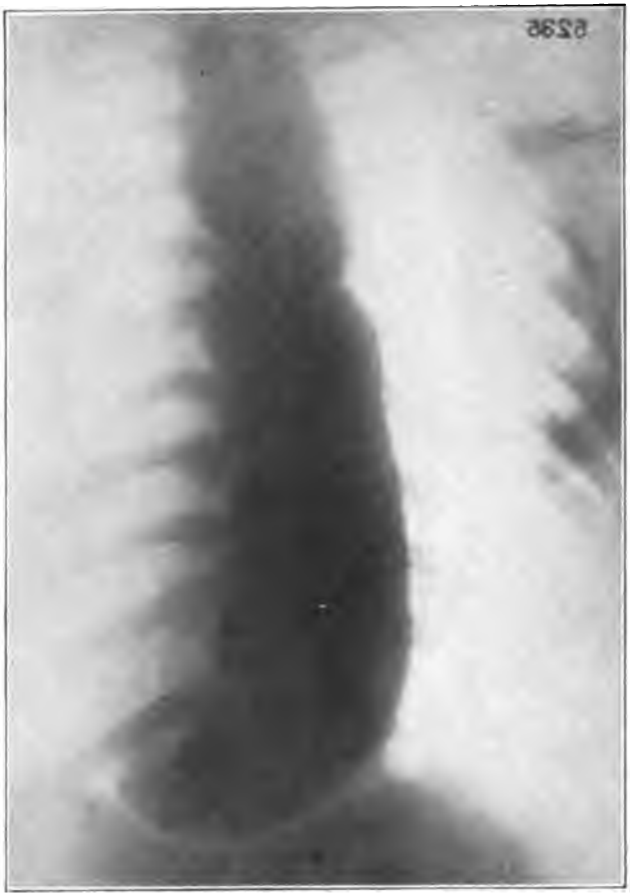

Fig. 8.—Diffuse dilatation of the esophagus in case of cardiospasm.

washed out. The heavier bismuth meals and the rubber bags filled with bismuth do not give any advantage commensurate with the discomfort caused the patient. The bismuth capsule

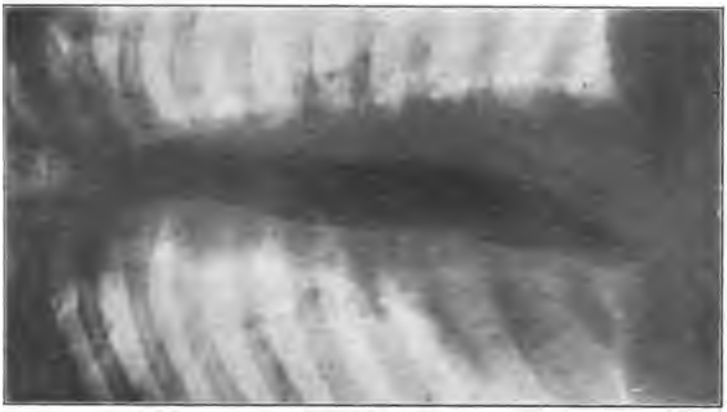

Fig. 10.—Diffuse dilatation of the esophagus in case of cardiospasm.

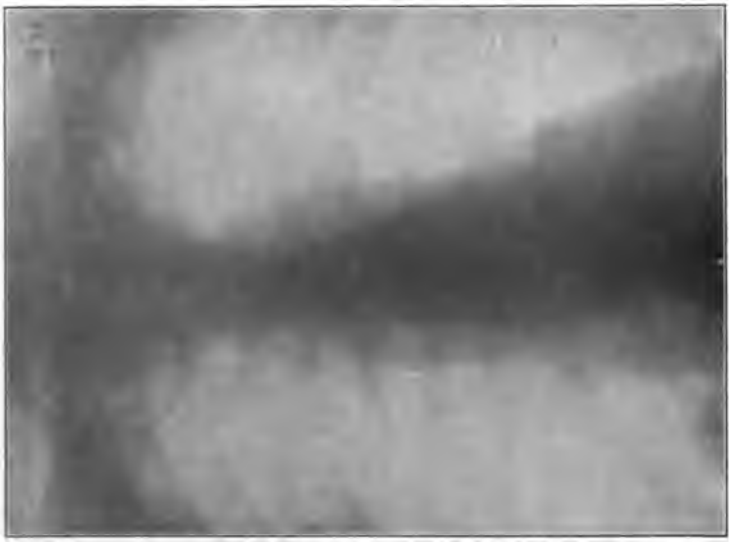

Fig. 9.—Diffuse dilatation of the esophagus in case of cardiospasm.

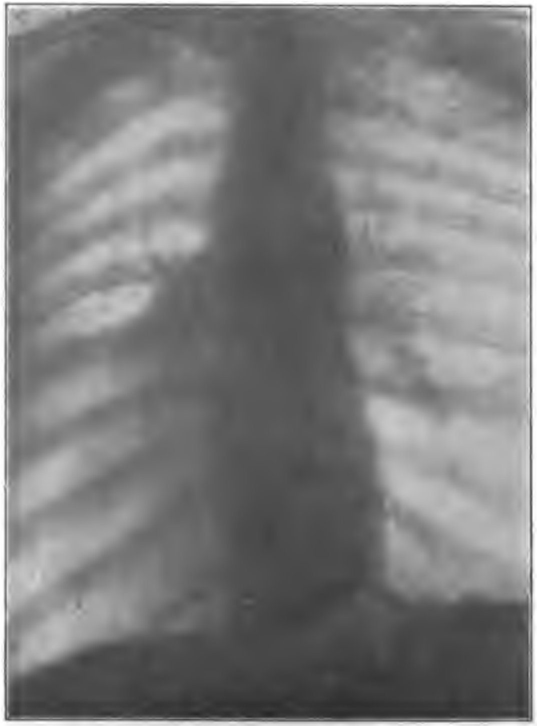

Fig. 11.—Diffuse dilatation of the esophagus in case of cardiospasm.

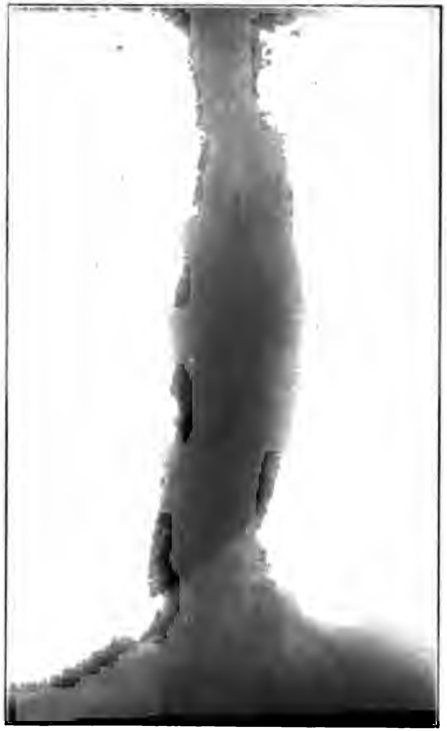

Fig. 12.—Diffuse dilatation of the esophagus in case of cardiospasm.

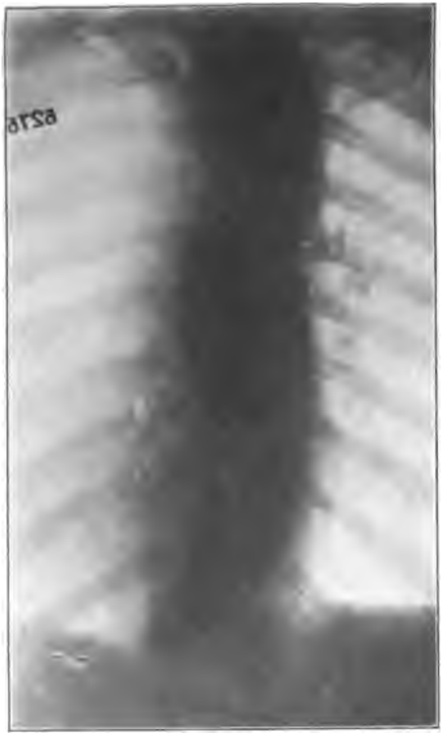

Fig. 13.—Diffuse dilatation of the esophagus in case of cardiospasm.

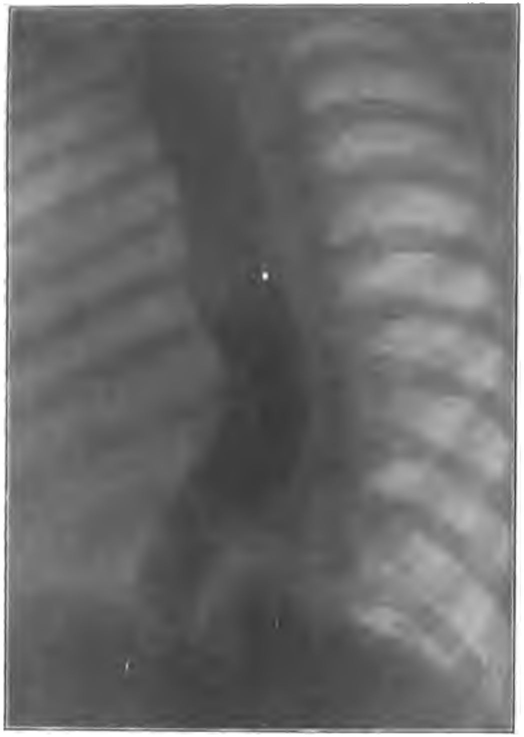

Fig. 14.—Diffuse dilatation of the esophagus in case of cardic-spasm.

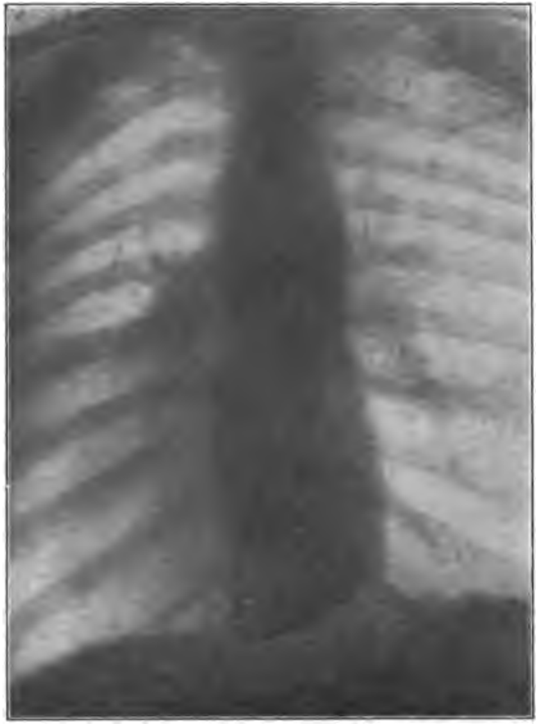

Fig. 11.—Diffuse dilatation of the esophagus in case of cardiospasm.

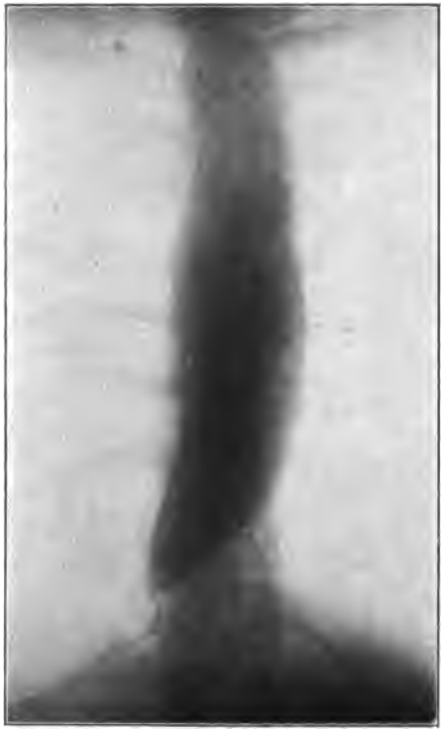

Fig. 12.—Diffuse dilatation of the esophagus in case of cardiospasm.

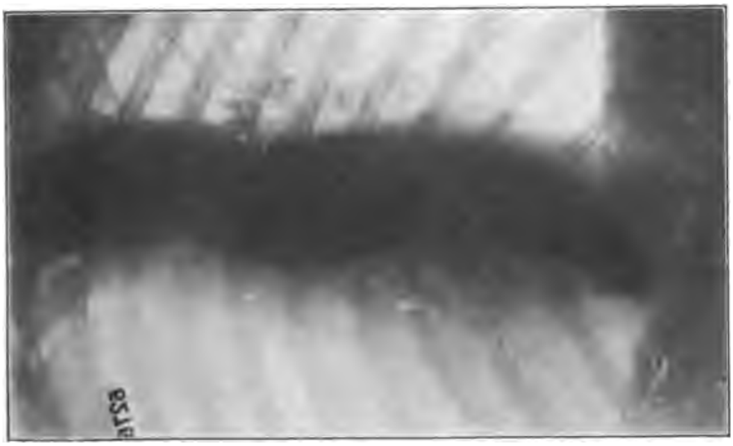

Fig. 13.—Diffuse dilatation of the esophagus in case of cardiospasm.

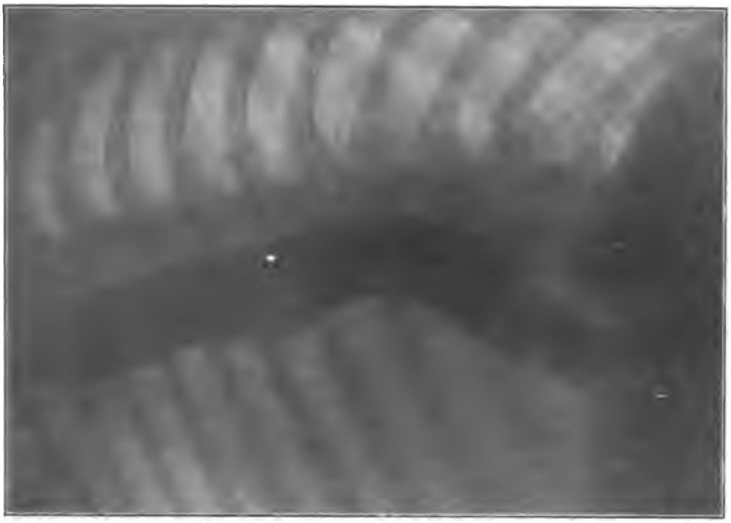

Fig. 14.—Diffuse dilatation of the esophagus in case of cardiospasm.

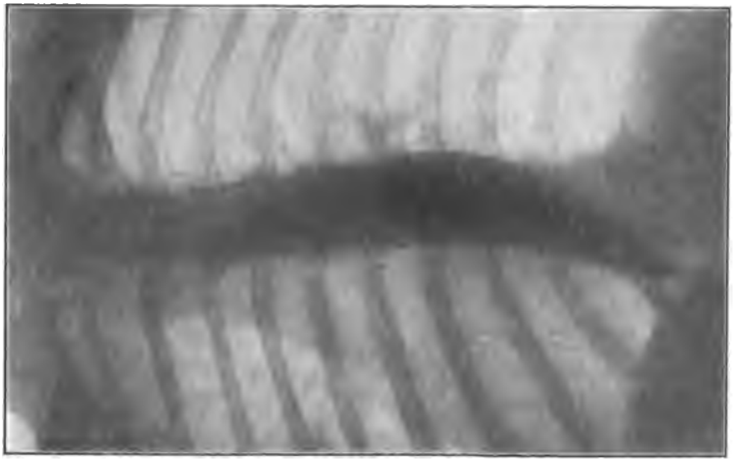

Fig. 15.—Diffuse dilatation of the esophagus in case of cardiospasm.

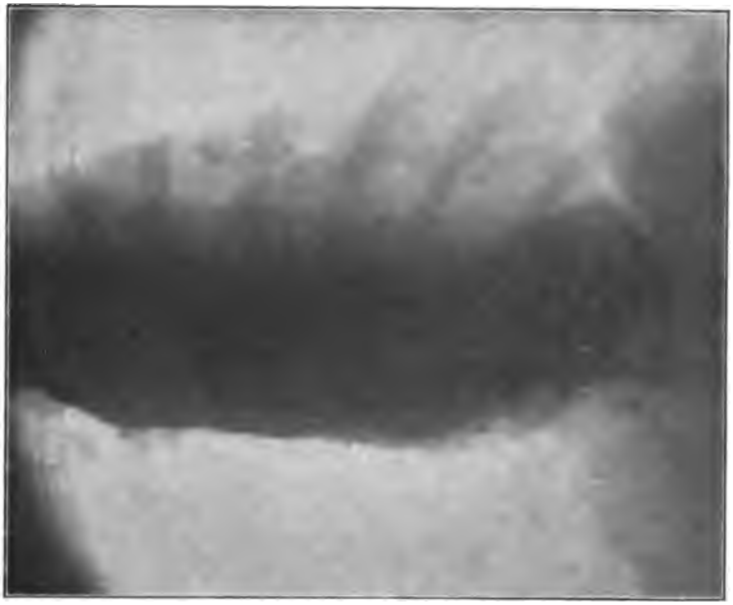

Fig. 16.—Diffuse dilatation of the esophagus in case of cardiospasm.

but rarely gives information not more easily obtained by other methods of examination. In patients complaining of slight or questionable dysphagia a delay in the passage of the bismuth may indicate grounds for an esophagoscopic examination.

In esophageal work, success, from both the diagnostic and the therapeutic standpoints, depends largely on our ability to pass instruments through the esophagus.

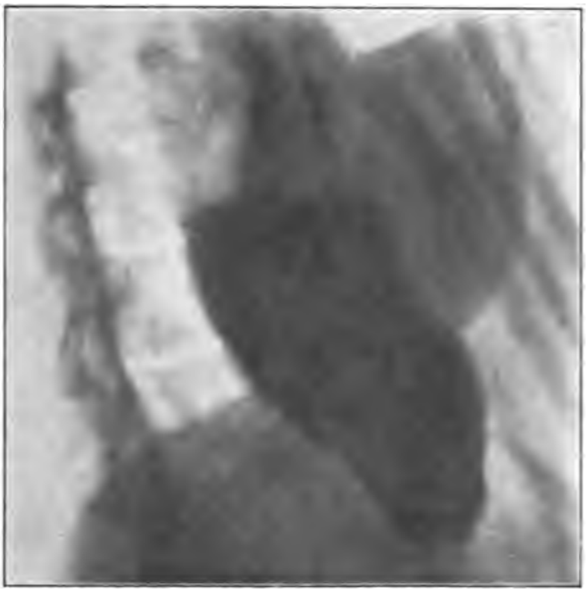

Fig. 17.—Diffuse dilatation of the esophagus in case of cardiospasm.

Safety should be the keynote in esophageal technic. This is to be obtained by a clear conception of the way in which the force is being expended when introducing an esophageal instrument. The force is dissipated either in overcoming the friction of the staff on the wall of the passage or at the tip of the instrument. Obstruction at the tip is due either to pocketing or actual narrowing of the lumen in the canal. Safety resolves itself into the recognition of pockets and avoidance of undue pressure on an instrument which is pocketed.

The tip of an esophageal instrument must be constantly under the guidance of vision or must follow a guide in such a way as to

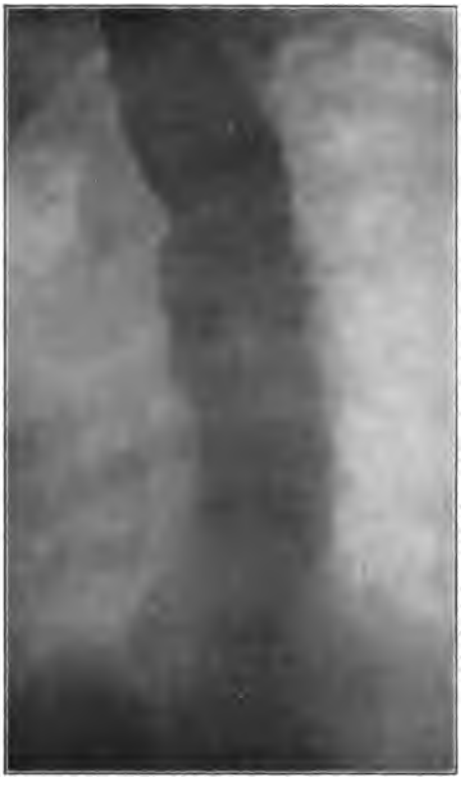

Fig. 18.—Diffuse dilatation of the esophagus in case of cardiospasm.

make perforation of the esophageal wall impossible. Let us conceive an instrument having the qualities of the finest silk thread at its tip, gradually merging into a rigid staff (Fig. 22). With patient persistence the thread could be passed through any patent esophagus and, if tension were maintained on the thread, the staff could be introduced into the stomach. This is mentioned to call attention quickly to the principles involved in successfully and safely introducing esophageal instruments. Such departures from this hypothetical instrument are permissible as the rigidity of the staff, tortuosity of the canal, necessary force, etc., permit, without invalidating the essential principles. The adaptation of Mixter's method of using a silk thread as a guide has proved of inestimable value. The patient swallows six yards of silk thread. This passes down through a sufficient number of coils of intestine to prevent its withdrawal on being pulled taut.

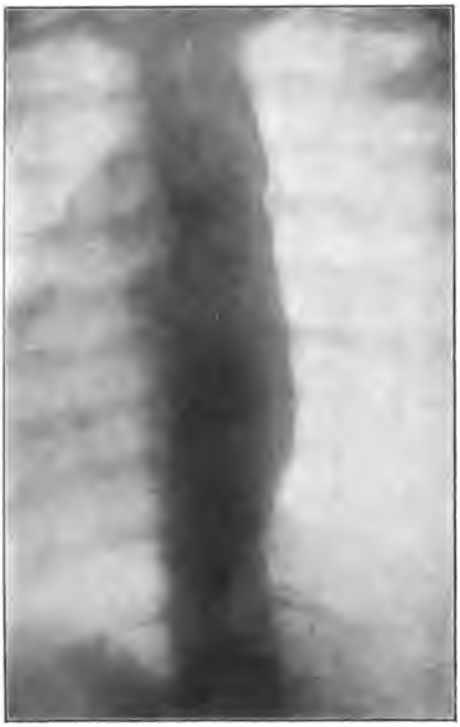

Fig. 19.—Diffuse dilatation of the esophagus in case of cardiospasm.

With the whalebone staff and olive passed on a silk thread (Fig.

23*b*) we may locate pockets, determine their depth, measure the diameter of strictures, divulse them, and estimate the rigidity of the esophageal wall at the seat of narrowing.

Only sufficient force to detect obstruction is permissible in advancing an unguided esophageal sound. With a silk thread that degree of force may be used which is short of carrying the thread out of its course and through the esophageal wall, or of endangering the esophagus by longitudinal traction, or of splitting the esophagus by a dilating wedge. If sufficient obstruction is encountered to make it seem possible that the thread might be carried out of its course, a piano wire (Fig. 23*e*) should first be passed on a thread

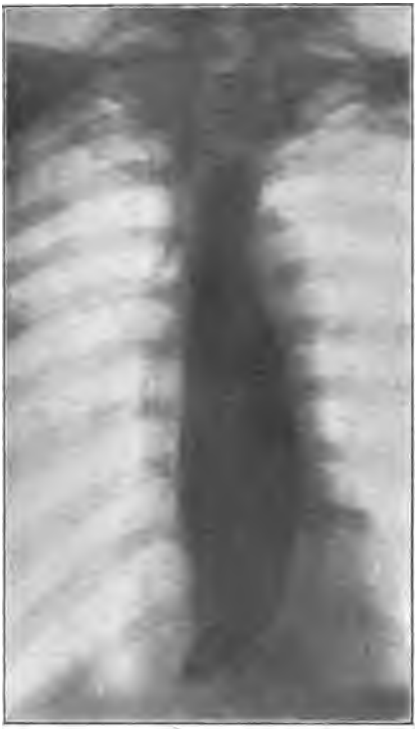

Fig. 20.—Diffuse dilatation of the esophagus in case of cardiospasm, apex of shadow corresponding to the hiatus œsophagi.

and the olive passed on the wire. With the wire in place the possibility of introducing a sound is assured. When passing an olive on the wire, tension on the thread should be maintained to avoid any possibility of the tip of the wire penetrating the wall of the stomach or esophagus. Figs. 24 and 23*d* show the distal portion of a piano wire guide and carrier for working the wire through a tortuous cicatricial stenosis on a thread. Various sizes of piano wire may be used and its flexibility further varied by the amount of wire exposed.

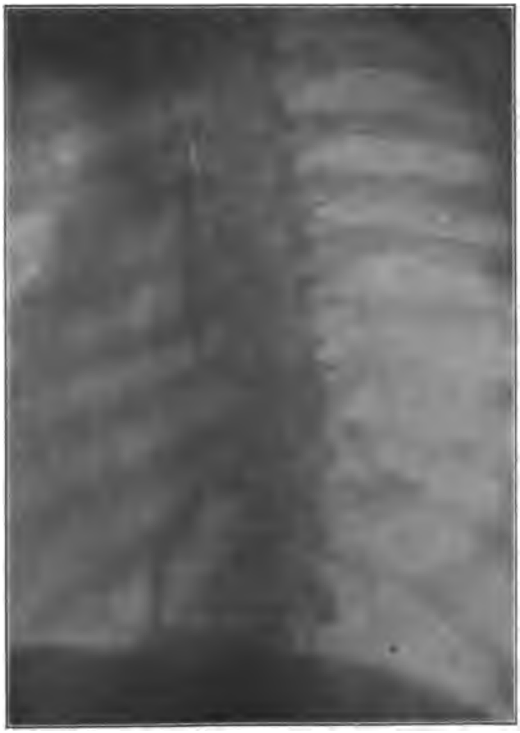

Fig. 21.—Dilatation of esophagus occurring above organic stricture.

In the treatment of cicatricial stenosis the wire guide is not often necessary after the first dilatation, and the thread may be dis-

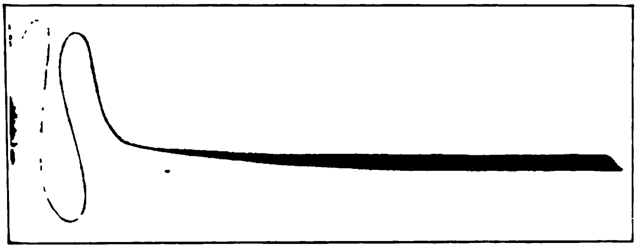

Fig. 22. - An ideal esophageal instrument, consisting of fine silk thread gradually merging into a more or less rigid instrument.

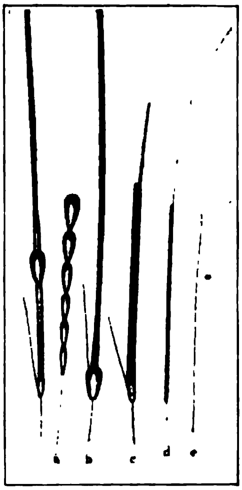

Fig. 23.—Various forms of esophageal sounds.

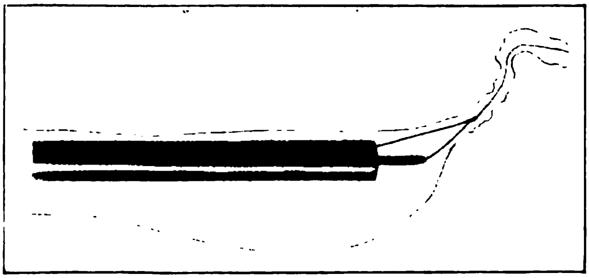

Fig. 24.—Piano-wire guide and carrier.

pensed with as soon as the smaller sizes of spindles will pass without encountering obstruction at the site of the stricture. Further dilatation is carried out with the sound shown (Fig. 23*a*); the flexible, spiral metal tip acts as a guide and the stricture is dilated with the olive inserted in the staff. In those dense, extensive strictures in which sufficient dilatation cannot be obtained by dilating with a spindle, I resort to a modification of Dunham's esophagotome, which utilizes Abbe's principle of cutting partially through the distended stricture by a string pulled back and forth.

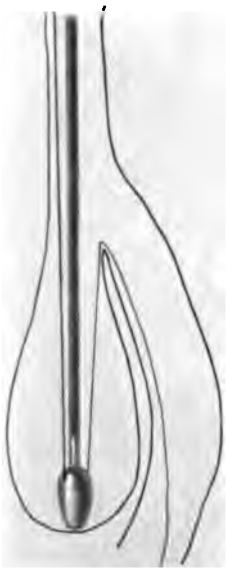

Fig. 25.—Sound pocketed in a diverticulum. Esophageal probe bulb threaded on a swallowed thread passed into diverticulum.

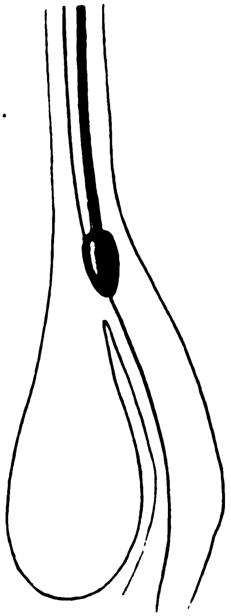

Fig. 26.—Traction on the thread lifting the sound out of the diverticulum. Probe bulb elevated by tightening the thread, showing depth of sac.

Without going into the reasons it is sufficient to state that an unguided sound will, as a rule, be pocketed if an opportunity is present. When introduced on a taut thread the sound follows the axis of the lumen of the esophagus. By varying the tension on the thread, obstruction from pocketing, and obstruction which is the result of actual narrowing of the canal, may be distinguished. The elimination of pocketing permits a more accurate determination of the diameter of the lumen and the rigidity of the esophageal wall at the seat of narrowing. Figs. 25 and 26 illustrate the use of a sound in demonstrating the existence of a pocket, its point of origin and more dependent portion. The sound is first introduced into the diverticulum until obstruction is encountered; holding the sound in place, the thread is drawn taut. Traction on the thread will now lift the sound out of the esophagus sufficiently far to bring the olive to a level with the opening into the distal portion of the esophagus. Until this point is reached the sound

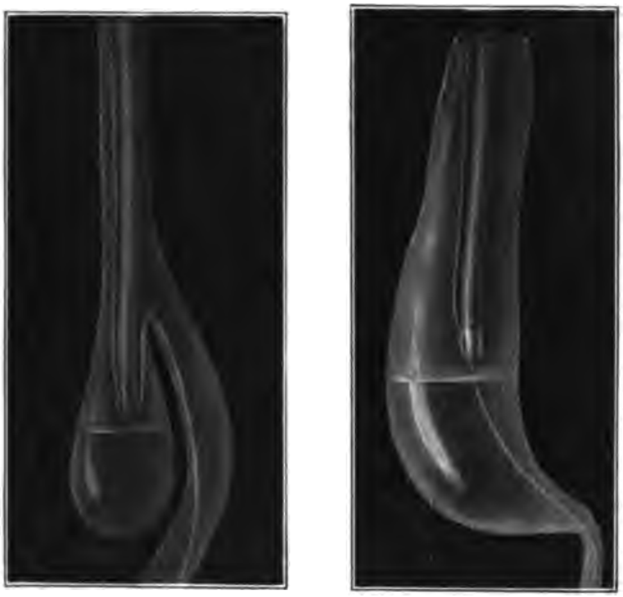

Fig. 27. Fig. 28.

Figs. 27 and 28.—Metal-tipped stomach-tube guided by a thread.

cannot be advanced without relaxing the thread. The same procedure, using a metal-tipped stomach-tube stiffened with a whalebone staff, permits of obtaining the contents of a diverticulum, dilatation, or of the stomach, with a definite knowledge of the location of the point of the tube and a certainty that it will enter the stomach (Figs. 27 and 28).

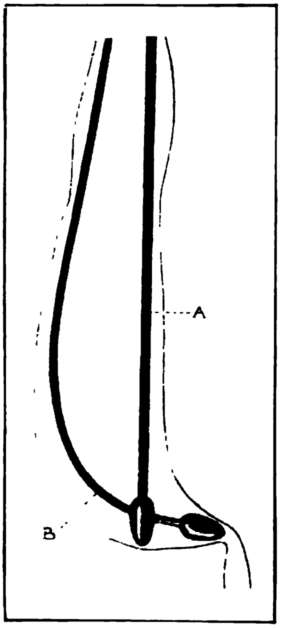

Fig. 29.—Diagram of diffuse esophageal dilatation, showing danger from stiff staff (*A*), together with use of flexible staff (*B*).

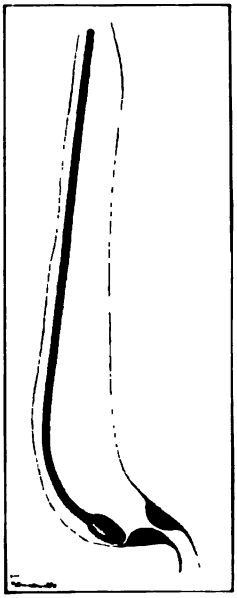

Fig. 30.—Passing a sound through a carcinomatous cardia.

Crowding a sound out of a pocket, or out of a pocket and through a cardia or stricture much larger than the olive, may give the impression of having passed a narrow stricture with rigid walls. The more accurate determination of the diameter of the lumen of the canal and the rigidity of the esophageal wall at the seat of narrowing, which the elimination of pocketing permits, is well illustrated by lesions at the cardiac orifice.

The thoracic portion of the esophagus is placed nearly in the median line, but deviates to the left as it passes forward to the opening in the diaphragm. In passing an olive through the lower three inches of a normal esophagus the staff impinges on the left anterior wall and the olive is directed to the cardia by the left posterior wall. This portion of the esophageal wall presents an increasing degree of obstruction as it approaches a horizontal plane in cases of diffuse dilatation. The degree of obstruction encountered depends also on the stiffness of the staff, the size of the olive and the tonicity of the esophageal wall. A stiff staff has a tendency to penetrate the esophageal wall (Fig. 29*A*), while a relatively flexible staff conforms to the right posterior wall and the olive approaches the opening in the diaphragm at an angle with

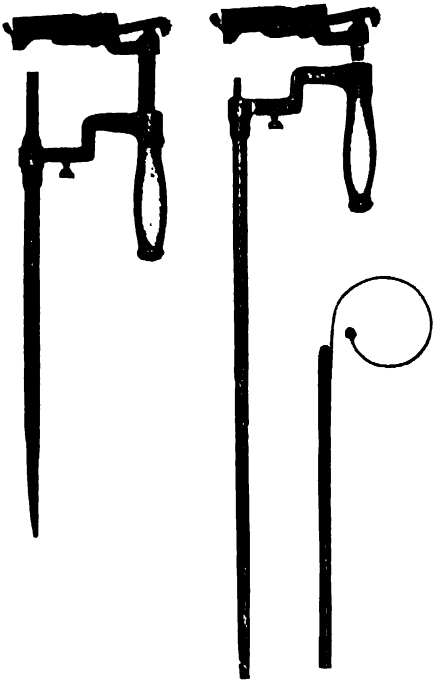

Fig. 31.—Brunning's modification of Killian's esophagoscope.

the axis of this portion of the esophagus (Fig. 29*B*). The rigidity of the esophageal wall and the ledge formed by the upper margin of the growth are also important factors in passing a sound through a carcinomatous cardia (Fig. 30).

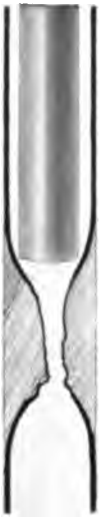

Fig. 32.—Esophagoscope obstructed by a ledge formed by infiltration beneath an intact mucous membrane.

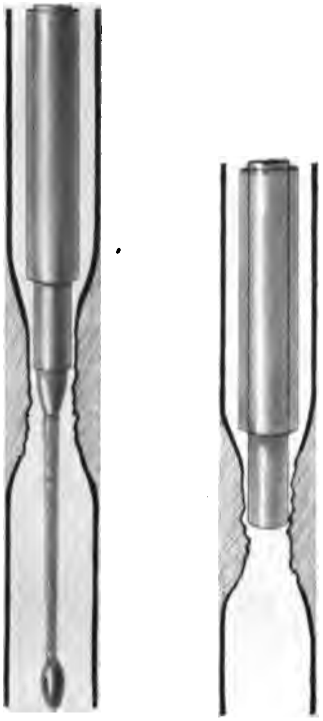

Fig. 33. Fig. 34.

Figs. 33 and 34.—Small esophagoscope introduced through a larger one, previously introduced and obstructed.

In cases of diffuse dilatation following cardiospasm it is frequently impossible to pass an unguided sound through the cardia with a degree of force that is safe (thirty out of sixty-five cases which have come under my observation), while a 15-mm. olive but rarely meets marked obstruction when passed on a thread.

Decided obstruction of yielding character, followed by slight hemorrhage, is usually encountered when passing a carcinomatous cardia, while in benign cicatricial stenosis the smallest sizes of olive encounter an unyielding esophageal wall.

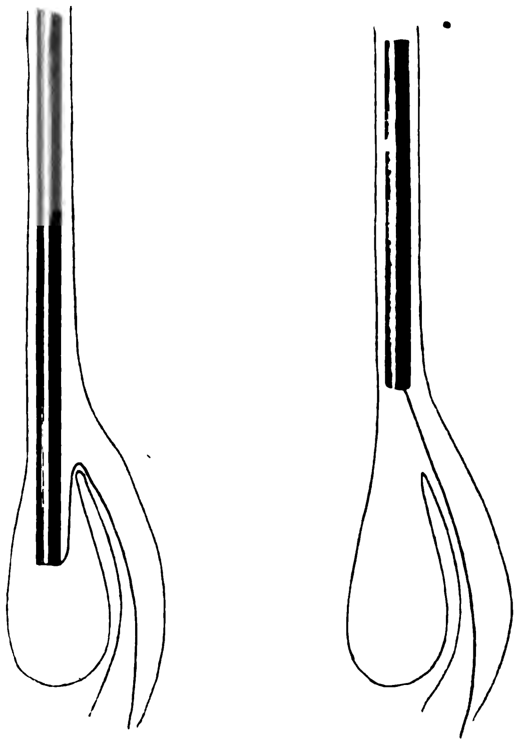

Fig. 35. Fig. 36.

Figs. 35 and 36.—Esophagoscope guided by a thread.

Leaving foreign-body cases out of consideration, the most essential service of esophagoscopy is that of revealing the character of the esophageal wall. It is a relatively safe procedure[1] in the hands of one who has acquired good technic. Safety lies in a clear conception of the way in which the force is being expended when introducing the instrument. Friction on the walls of the passage is an important element, as it makes advancement of the instrument jerky and obscures any fine sense of resistance at the tip of the instrument. I wish to call attention to Brunning's modification of Killian's esophagoscope (Fig. 31). It has a convenient and a sufficiently strong handle to permit of bringing the cardia into view, a light that rarely fails at the critical moment, a short upper section with a tip well adapted for easily passing the cricoid, and that eliminates friction in introducing a telescoping section through the lower portion of the esophagus. A satisfactory examination can, in the majority of cases, be made without an anesthetic in less than five minutes. In rare instances a guide becomes necessary to pass the cricoid, a ledge of mucous membrane, or a

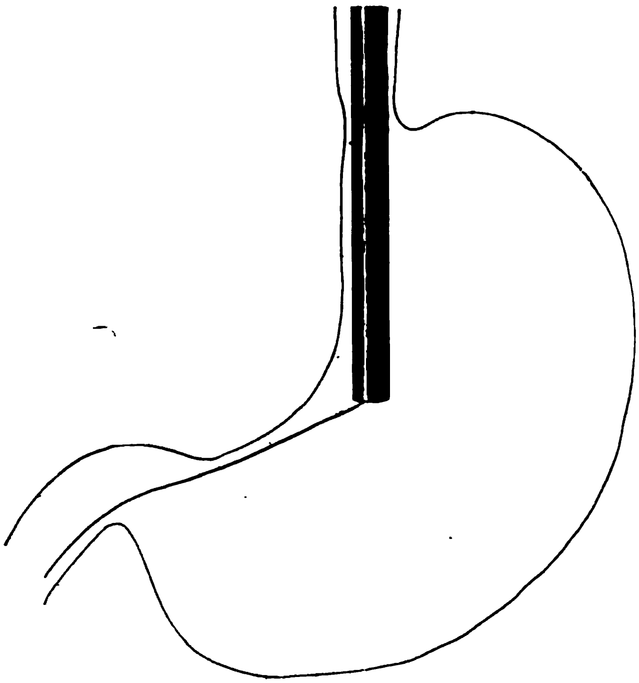

Fig. 37.—Thread used as a guide in gastroscopy.

tortuous esophagus, the lumen of which is large enough to admit an esophagoscope. This guide must follow the lumen of the esophagus in such a way as to make perforation with its tip impossible. At its tip it should be sufficiently flexible to follow the lumen of the canal or a silk thread, and yet not double on itself. From its tip it should gradually merge into the rigid staff of the esophagoscope so as not to permit of any abrupt curve or ledge which might bruise or gouge the mucous membrane.

In esophagoscopic work one of the chief drawbacks is the constriction of the esophagus above that portion of the esophageal wall essential to our knowledge. In about 35 per cent. of the cases of carcinoma, for instance, the mucous membrane is intact at the lowest point on the esophagus which can be brought under inspection. Fig. 32 illustrates an esophagoscope obstructed by a ledge formed by infiltration beneath an intact mucous membrane. A small esophagoscope may be introduced through a preceding one, with a guide, sufficiently far to bring the involved mucous membrane into view (Figs. 33 and 34). The elimination of friction by the first instrument introduced permits of safely carrying out this procedure in a good many instances.

Occasionally the thread is a valuable guide in following the course of the esophagus with the esophagoscope. To the experienced operator this is not of much advantage, except in cases of congenital malformation and in locating the slit-like opening into the distal portion of the esophagus in cases of diverticula (Figs. 35 and 36). When drawn taut, the thread impinges on that margin of the distal opening of the esophagoscope toward the lumen of the esophagus. In direct gastroscopy, orientation is much facilitated in a similar manner (Fig. 37).

DIAGNOSIS AND SURGICAL TREATMENT OF ESOPHAGEAL DIVERTICULA*

REPORT OF EIGHT CASES

By CHARLES H. MAYO

Diverticula or pockets which occur along the esophagus and lower pharynx, although somewhat rare, are so great a menace to health when they do occur that their early recognition is of the utmost importance.

In 1840 Rokitansky described and made two classifications of diverticula of the esophagus. Those developing from internal pressure he termed "pulsion or pressure" sacs; the variety originating from the scar or contraction of inflammatory processes adjacent to the canal, "traction" sacs. The *traction* sacs are usually produced by infections involving glands about the left bronchus. They give very few symptoms during life and seldom concern the surgeon, as they usually are found only at autopsies.

The greater number of diverticula of the esophagus are of the pharyngo-esophageal type and are found in the lower pharynx or upper esophagus, because at this point, sometimes called the "Lannier-Hackerman area," there is a natural deficiency of muscular support where the pharynx merges into the esophagus, particularly on the posterior side. In this region also, through anomaly of development in closure of the lower branchial clefts, conditions may occur which favor the development of diverticula. Only a few cases have been reported as found in the middle and lower third of the canal. The narrowest part of the esophagus is at a point opposite the cricoid, which measures by bougie 5 or 6 inches from the incisor teeth. Naturally there is increased pressure above this point in swallowing. A mucous pocket between the muscle-fibers may project here, and once started it mechanically increases all of the conditions which caused the difficulty originally.

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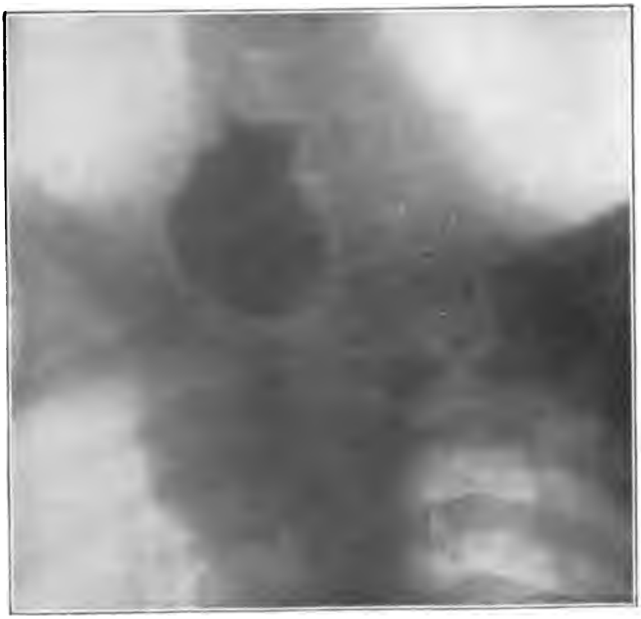
* Reprinted from "Annals of Surgery," June, 1910.

Diverticulum is a condition confined to adult life, and gives practically no symptoms until difficulty in swallowing is experienced. Then a cough may occur from nerve irritation, and pressure from behind the trachea often causes coincident dyspnea. The dysphagia is not unlike that occurring with stricture which has followed erosion or is the result of malignant disease. Cardiospasm may produce much the same difficulty in swallowing, with eructation of food, after dilatation has occurred, yet a stomach-tube may be readily passed in this condition. Stricture obstructs the passage of food, and, the onset of the condition being slow, may result in some dilatation above it, with food regurgitation. The depth of the obstruction can be measured with a stomach-tube, bougie, or acorn probe, and passable strictures may be dilated by means of the probe. These soundings and measurements do not, however, differentiate between diverticula and strictures which are pervious to liquids and yet impassable to sounds. As a rule, the larger diverticula appear as an extension of the proximal canal, the distal esophagus opening in front above the entrance to the sac. However, traction by distention may drag the opening to a lower level.

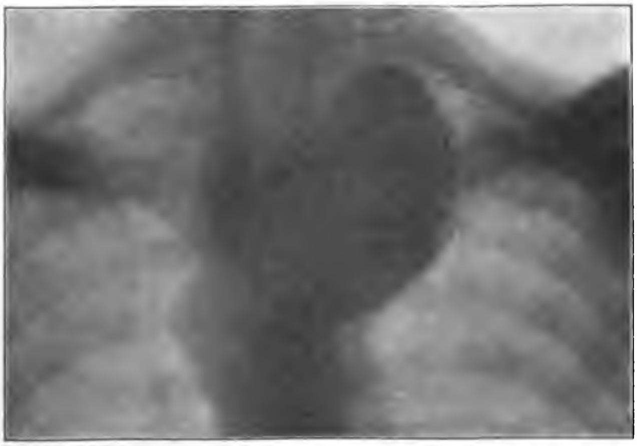
A large diverticulum distended by eating has the appearance of a tumor in the neck, and pressure upon this tumor forces the contents back into the pharynx. In these cases tubes and probes pass to the bottom of the sac, although in the early stages of the difficulty they often pass without obstruction into the stomach. Special blunt-tipped probes can be used in extreme cases to locate the distal esophagus. If diverticula are discovered in the early stages, they may be cured and prevented from recurring by the occasional passage of dilators through the narrowed part of the esophagus.

In making a thorough examination of the esophagus, credit should be given the esophagoscope for its usefulness in cases of

PLATE 1

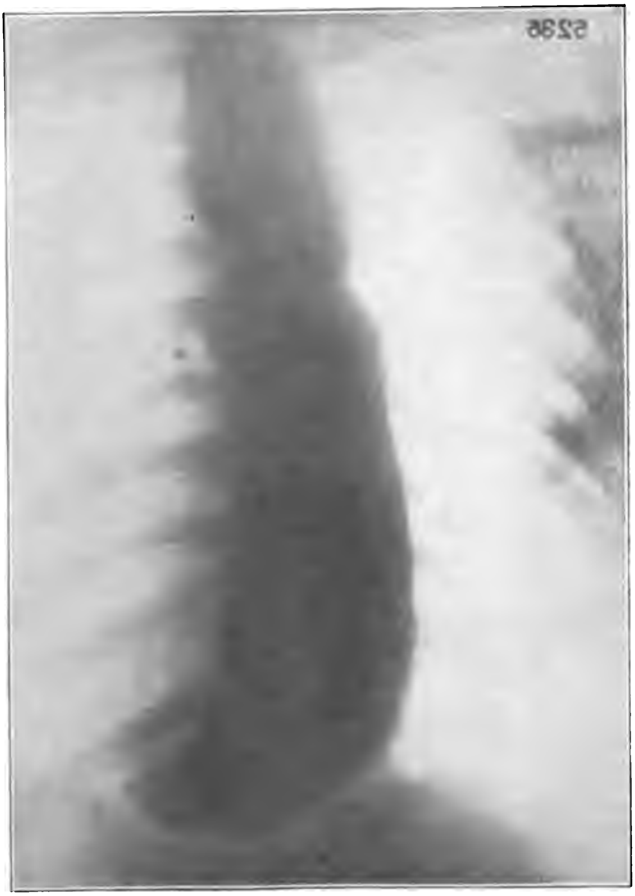


Diverticulum of esophagus, from skiagraph.



Diverticulum of esophagus, from skiagraph.

PLATE 2



Diffuse dilatation of the esophagus in case of cardiospasm.

obstruction, and especially in removing portions of growths for microscopic examination; however, the procedure requires practice to make it of practical value as a means of diagnosis. Rumpel's multiple tubes and liquids as a method of diagnosis are of value only in exceptional cases. Radiographs, obtained after filling the sac with bismuth and acacia mixture (Plates 1 and 2), are of marked value in indicating the size, shape, and location of the pocket. The modifications of the method by skiagraph, that of swallowing a chain or inserting a shot-filled tube, are of less practical value. The same can be said of the Strauss method of measuring the capacity of dilatations and diverticula by passing collapsed balloons fastened upon stomach-tubes to be filled with a measured quantity of air.

Owing to the supposed difficulties of making an examination, these patients have been neglected during the early stages and have very often been sent to the surgeon in an exhausted and starved condition, when operation is naturally attended with some risk. At this time the disease may be diagnosed malignant, and gastrostomy made for feeding; in fact, a number of cases have been correctly diagnosed only when they failed to die of carcinoma after an assumed proper period following gastrostomy. This operation has crept into the treatment of the advanced obstructive cases until the procedure has an accepted position as a means of immediate relief from impending starvation.

Since the excellent description by Rokitansky, many other articles descriptive of the condition have been written. The contributions of Zenker,* A. E. Halstead,† and De Witt Stetten‡ are all interesting reviews of the subject and they furnish extensive bibliographies.

I wish to call particular attention to one means of diagnosis used by H. S. Plummer (Plate 3), which has not heretofore attracted the attention it merits. The patient is instructed to swallow three yards of button-hole silk twist, and the next morning to swallow three more yards of the continuous thread. If there is an opening through the stricture or out of the diverticulum, this thread will be washed on into the stomach and from there into the bowel a sufficient distance to stand traction without being withdrawn. The examination is now accomplished with a whalebone stem and several sizes of olive tips to attach to it. The thread is passed through an opening in the end of the olive and out of its side. The probe is passed down the esophagus on the thread, which is held loosely until obstruction is encountered. Should the trouble be due to stricture, the tip will not change its level when the thread is tightened, but if there is a diverticulum the probe will be elevated to the level of the opening into the lower esophagus, proving at once the existence of a pocket and also its depth by the amount of elevation of the probe upon tightening the thread. It is not necessary to perform gastrostomy for the purpose of feeding these patients preparatory to operation; the thread can be left in place, by means of which the stomach-tube may be passed when desired for feeding. This was done in Case VII, a patient reduced from 135 pounds to 90 pounds by starvation. At the end of three weeks' feeding an operation was done and the sac, which easily held 16 ounces of fluid, was removed.

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* Ziemssen, Encyclopedia.

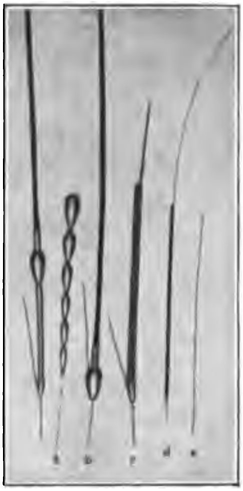
† "Annals of Surgery," Feb., 1904.

‡ "Annals of Surgery," March, 1910.

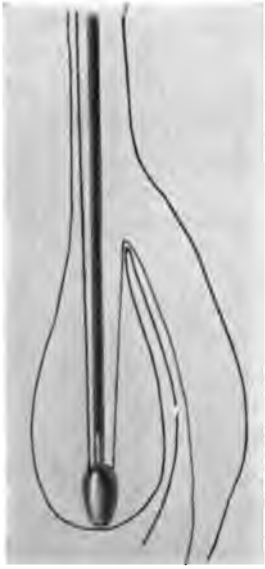
Dunham has shown how a thread can be washed or swallowed through a small esophageal *stricture* into the stomach, and later be used as a tractor for the dilator, after performing gastrostomy. Mixter discovered that when the thread had passed into the intestine a few feet, if held taut it could be used as a guide for dilators in case of *stricture.*

The operative procedures have been quite simple in all but two of our cases, which required subsequent closure of fistulas. Incision is made along the inner margin of the sternomastoid muscle which is tracted outward; the anterior sternal neck muscles are drawn inward. The lobe of the thyroid is now elevated and the lateral thyroid vein ligated and cut. The sac can usually be identified, but should any doubt exist, a urethral sound can be passed down the pharynx and its point used to elevate the sac into the wound. Care must be used to preserve the recurrent laryngeal nerve from injury. The sac is opened and an examination made

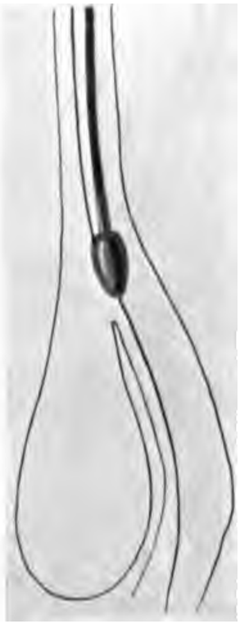
PLATE 3



Various forms of esophageal sounds.

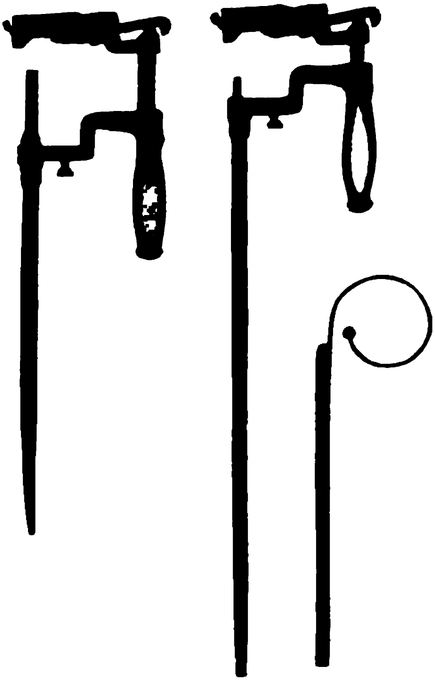


Sound pocketed in a diverticulum. Esophageal probe bulb threaded on a swallowed thread passed into diverticulum.



Traction on the thread lifting the sound out of the diverticulum. Probe bulb elevated by tightening the thread, showing depth of sac.

PLATE 4



Brunning's modification of Killian's esophagoscope

of its interior. It is then amputated and the wound closed by a continuous mattress suture, like an intestinal opening (mucosa inside), and a Cushing parallel suture of fine catgut is inserted to reinforce the closure. The wound is washed with a weak solution of iodin and a temporary drain of rubber tissue is inserted. In one of our cases the contents of a very large sac was forced into the pharynx during the operation and a considerable quantity of the material was inspired into the lungs. The head of the table, which was raised, was lowered immediately and the fluid escaped into the mouth. Fortunately no harm was done, but the accident pointed out the necessity of emptying large sacs before operation. In this particular case the diverticulum was so large that it extended far into the mediastinal space. To avoid the infection of such a large space, the large empty sac was drawn out of the neck and ligated. Closure of the short stump fistula was accomplished later by passing a thread through the mouth and out of the fistula by means of an eyelet sound. The fistula was separated, the thread attached to it, and the short tract inverted into the pharynx, applying three separate circle sutures as it is turned in. The external wound healed quickly. Diverticula are sometimes treated in this manner without opening them externally. Four cases were treated by amputation of the sac and immediate suture; all healed without leakage.

In the after-care a large quantity of fluid saline is given by slow enemata (Murphy), and patients are fed twice a day by passing a small stomach-tube. Sips of hot water are permitted at rare intervals on the second day.

I wish to report in this paper six cases which were published in the Transactions of the Minnesota State Society, but do not appear in any collected statistical report; and two cases which have not heretofore been reported. Eight cases of esophageal diverticula have been diagnosed in the clinic at Rochester. Six were operated upon without mortality. Perfect relief followed. Two have not been operated.

Case I.—Male, aged forty-three years. Compressible tumor in neck. Obstruction below cricoid. Diagnosis: diverticulum. Operation, 1898. Incomplete removal of sac; prolonged fistula. Second operation for closure.

Case II.—Male, aged thirty-three years. Compressible tumor in neck; examination corroborated by *x*-ray. Obstruction 20 cm. from incisor teeth. Diagnosis: pharyngo-esophageal diverticulum. Operation advised but not accepted.

Case III.—Male, aged forty-six years. Trouble for eighteen months. Food regurgitation fourteen months. Compressible tumor in neck. Obstruction 21 cm. from incisor teeth. Radiograph with bismuth: examination revealed pharyngo-esophageal diverticulum. This patient was advised operation but failed to return.

Case IV.—Male, aged fifty-six years. Obstruction 23 cm. from incisor teeth. Compressible tumor in neck. Diagnosis: pharyngo-esophageal diverticulum. Operation April 8, 1908. Excision of sac. No leakage.

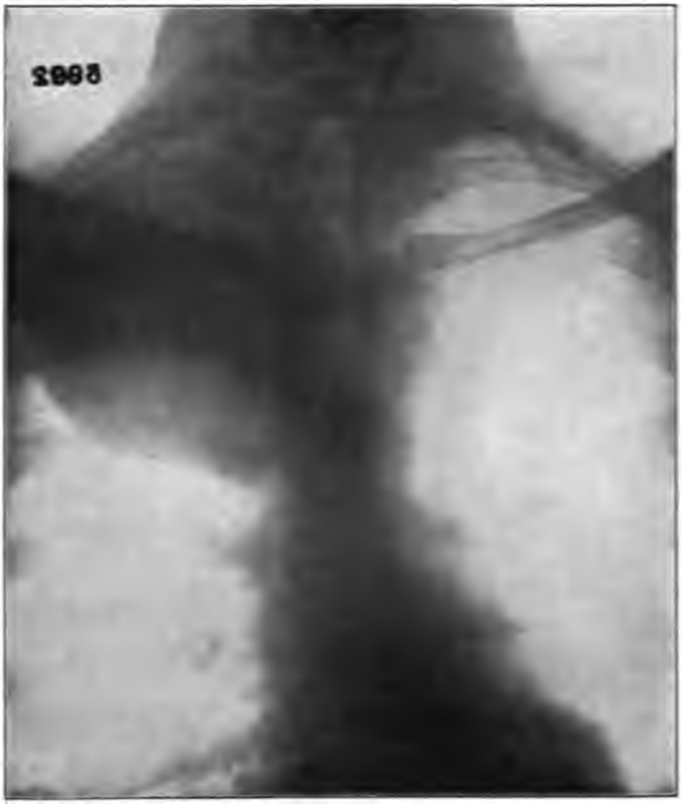
Case V.—Male, aged forty-five years. Regurgitation of food. Cough. Obstruction 20 cm. from incisor teeth. Pharyngo-esophageal diverticulum. Operation June 9, 1908. Excision of sac. No leakage.

Case VI.—Male, aged sixty years. Trouble for two years. Radiograph revealed sac 3 cm. in diameter in the median line. Operation June 9, 1909, for pharyngo-esophageal diverticulum. Excision of sac. No leakage.

Case VII.—Male, aged fifty-five years. Large compressible tumor of neck. Loss in weight from 130 to 90 pounds. Total obstruction of food. At times some liquid passed. Had been nourished by bowel enemata for a short time before coming for examination. Stomach-tube was passed down the thread and he was fed daily for three weeks; gained 15 pounds. Operation April 4, 1908. Sac removed. Fistula purposely left in neck of sac; closed subsequently by operation.

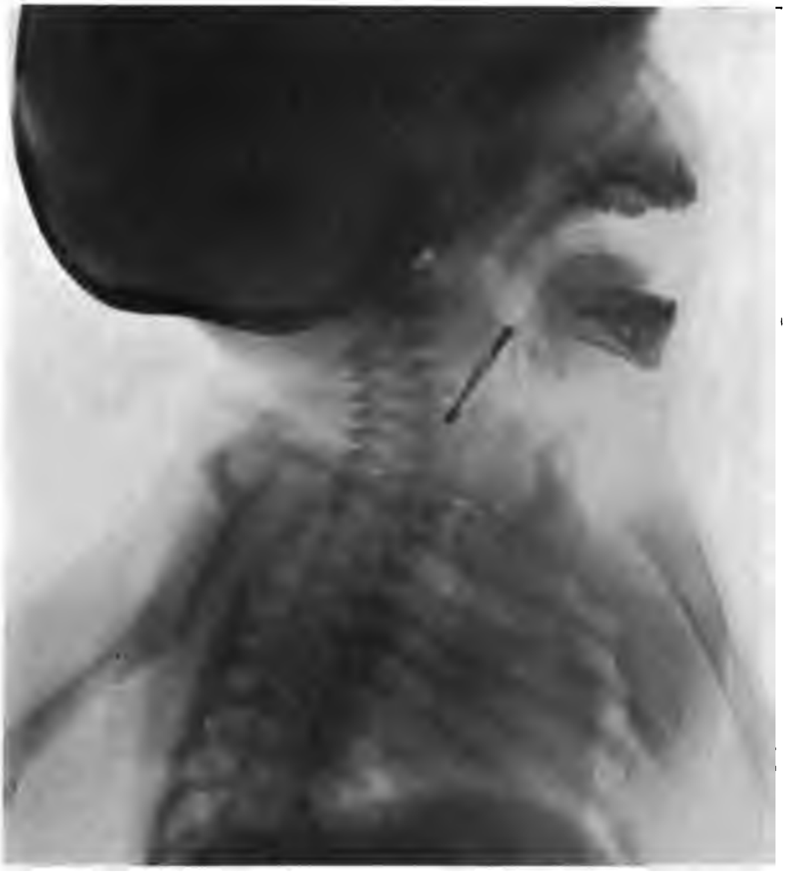
Case VIII.—Male, aged forty-five years. Symptoms for five years. Regurgitation of small amounts of food. Diagnosis: esophageal diverticulum. Operation November 3, 1909. Diverticulum removed. Recovery.

PLATE 4 A



Substernal adenoma of the thyroid.

PLATE 4 B



Radiograph showing foreign body in the esophagus

DIFFERENTIAL DIAGNOSIS OF DISEASES CAUSING GASTRIC DISTURBANCE*

By CHRISTOPHER GRAHAM

Peptic ulcers furnish the typical dyspeptic syndrome. Duodenal and pyloric ulcers give a train of symptoms that is peculiarly characteristic, almost pathognomonic. Histories of patients at the surgical clinics show (1) that most of them have suffered more or less for years, (2) that during the years alternating periods of attack and perfect or partial health are clearly defined. The attacks come more often in the spring and fall, especially early, but they may be irregular, coming and going quite without known cause. During an attack pain, distress, burning, vomiting, gas, and pyrosis—one or all may be present and always at a time peculiarly regular for the patient. Two to four hours after meals the patient feels the return of symptoms, which at their height may quite prostrate him. He has a hungry, burning, sour feeling in stomach; pain, distress, gas, and sour vomiting may be present. Food taken gives ease. Anything that engages the acid, and neutralizes it or removes it, brings comfort. Early hearty meals give most relief. What quiets pain, quiets all symptoms. This regular return of symptoms two to four hours after food, and their control by food, drink, alkalies, vomiting, etc., meal after meal, day by day, during the attack, is peculiar to peptic ulcer only. When complications have arisen the symptoms may be continuous, and so changed that they may be common to many diseases. To get at the diagnosis properly at this late stage the early history is necessary.

*** Read at the 41st annual meeting of the Minnesota State Medical Association, held at Winona, Oct. 14 and 15, 1909. (Reprinted from the "Northwestern Lancet," April 1, 1910.)**

Cancer.—In developing histories from those suffering from gastric cancer, we have found them to fall into three classes: first, those in whom the disease seemed to appear suddenly during the enjoyment of perfect health; second, those in whom an attack or attacks in earlier years are definitely stated, and who, for years, have been well until sudden grave symptoms (as in Class 1) threaten; and, third, those who for years had typical attacks of chronic gastric ulcer. In the first and second classes we may find tumor, advanced lesions, and symptoms of previous chronicity suddenly and very acutely developed. We may find those patients whose only complaint is a diffident weak feeling, and who are chiefly concerned because an epigastric tumor has been discovered. Others complain of languor, weakness, loss of appetite, and emaciation; and on physical examination nothing is revealed. The test-meal is of value here. We feel sure that, however great the difficulties here met with in reaching a diagnosis, they are less than in Class 3, where ulcer has been apparent for years. Some patients are weak, emaciated, and cachectic when ulcer is the only lesion. A palpable tumor and vomiting of delayed food, poorly macerated, with coffee-ground appearance, may be present, and ulcer still be the lesion; but tumors of the stomach are usually cancer (95 per cent.). When cancer has once fastened itself upon the stomach, the course is short and steadily downward, and remissions are seldom experienced. Pain in cancer is quite a constant symptom, though less often noted than in ulcer. It is less acute, more continuous, a dull, strange, depressing ache, and usually immediately intensified by ingested material. It is epigastric, and tender areas are not common. In cancer so-called "pyrosis" may increase in time and amount, but loses its acidity. Regurgitation, day or night, is also increased in amount and likewise loses its acidity. Vomiting is often more delayed, more copious, oftener blood-mixed, and gives a peculiar and great relief, though rarely so complete as in ulcer. Vomiting and nausea are more often excited by liquid food; gas and bloating become more chronic and distressing; appetite is lessened and finally lost, or a disgust for food is felt. Emaciation comes on rapidly; pallor, anemia, and weakness hasten; loss of power is marked; desire for activity is wanting; and a great languor is felt. Food, instead of giving relief, is quite apt to produce immediate pain, which may be acute, but oftener is dull, sickening, almost indescribable, or a strange distress, not related to food, is common and continuous. With all this there is a mental depression as though a consciousness of impending evil. This mental attitude is the great factor that gives to the face the expression that so often marks the patient who suffers from malignant disease. No symptom or symptoms seem sufficient by which to diagnose cancer of the stomach; the facies, the general appearance, the mental attitude, the physical condition, the direct gastric symptoms—all form a composite picture, a glance at which may make the diagnosis.

Gall-stones.—In gall-bladder disturbance there are, first, those cases of mild disturbance, usually gastric and often lightly considered by the patient and even more lightly by the physician. These are light attacks of distress, gas, upward pressure, coming often soon after food or at irregular times, often of sudden onset, short duration, eased by belching or perhaps slight vomiting, regurgitation, or slipping away almost unnoticed and without treatment, though many and various measures may get credit for natural return to health. These sudden, irregular, mild "dyspeptic" attacks are quite as typical of gall-bladder disturbance as are the severe typical attacks which, as a rule, supplant the mild. Second, there is another set of cases with more or less prolonged, dull (mild or quite severe) pain in the epigastric area, right arch, or whole liver-area. This pain may be increased by food, exertion, or motion; deep respiration gives pain, and when entirely located posteriorly, the trouble may be called pleurisy. These patients pass through prolonged steady attacks, then ease may alternate with distress, and comparative or excellent health may be enjoyed for a time. During an attack, dyspeptic symptoms are prone to be present, and but for this irregularity, as compared to ulcer, one might often consider gastric lesions. Third: In this class is to be found the great number upon whom the correct diagnosis falls, and in this class surgery finds its greatest activity and rewards its adherents by giving great relief and lengthened days. Here we have the so-called typical gall-stone attack—sudden severe epigastric pain, with radiation to the right arch (at times to the left), and through to the back or the scapular region, spasm of the diaphragm, upward pressure, gas, nausea, vomiting, and after a longer or shorter terrific spell comes sudden cessation of symptoms, and, until complications have obtained, almost immediate return to perfect health. A sudden onset and sudden cessation, without apparent cause or any treatment, are quite peculiar to gall-stone disease when no complications are present. These attacks come irregularly, night or day, and often bear no relation to food, though often called acute indigestion, gastralgia, neuralgia of stomach, and other equally erroneous names. The fourth condition is that of chronic gall-bladder trouble,—adhesions, duct-obstruction, perforation, contractions, duct-infections with pancreatitis. Often in this class chronic gastric disturbances predominate, and the picture is so closely related to chronic ulcer with complications that a differential diagnosis cannot be clearly made if only present symptoms are considered. At this stage the key to diagnosis depends on the development of the early history.

Chronic recurring appendicitis is the type that usually gives stomach symptoms. There is no appendiceal tenderness, no pain at McBurney's point, no fever, no tumor, no symptoms that usually mark appendicitis, except those referred to the stomach. There may be pain, gas, vomiting, sour stomach, and pyrosis, but when compared with peptic ulcer they are irregular, and when gall-stones are considered the attack is too prolonged. The whole train of symptoms is caused more often immediately by food, but this meal gives one effect and the next meal another. There is no regularity, meal after meal, as in chronic ulcer, and rarely does food give ease. Pain is often a queer, rather continuous distress, which is epigastric or indefinitely abdominal, which the patient describes as epigastric. There is no clean-cut day-by-day repetition, as in ulcer, and no attacks like gall-stones of definite location of pain. Nausea, distress, a gassy, bloated condition covers the bad feeling of more cases of chronic appendicitis than of chronic ulcer or gall-stones. Exertion is a factor in appendicitis, and sufferers from it are seemingly often unable to work. Pain may be epigastric only, but often indefinitely of the epigastric and abdominal regions or low gall-bladder or high appendix areas. If we have dyspeptic attacks with epigastric pain and radiation to the umbilicus or lower abdomen, consider, first, appendiceal disturbance.

Syphilis, when it attacks the stomach or liver, may clearly simulate ulcer of the stomach or gall-stones, and when quite advanced, the pain, cachexia, and vomiting may lead to a strong suspicion of cancer of the stomach. The vomiting of crisis may mislead; however, the attacks are peculiarly sudden, the vomiting is irregular, often soon follows introduction of food to the stomach, but appears if total abstinence is practised. Perhaps little pain (nausea), not so often sour stomach, no hunger-pain, no food relief, or other characteristic of peptic ulcer is present. There is usually not so much emaciation, because attacks are not, as a rule, so prolonged. The attacks cease as abruptly as they begin, and no signs of trouble remain. No regularity of ulcer; no picture of gall-stones. A history.of specific infection, shooting pains of a general character, and other specific signs will cause the physician to hesitate. Specific treatment often clears up the diagnosis.

Many patients with pulmonary tuberculosis will present themselves with a diagnosis of stomach trouble, not a few of them fearing ulcer or cancer. Anorexia, food-pain, vomiting, emaciation, and cachexia are present, and hydrochloric acid is absent. An examination reveals irregular fever, cough, bacilli, lung complications, or other tuberculosis foci; and the clinician should not remain long in doubt concerning the correct diagnosis. Tuberculosis of the intestines (colon) often gives dyspeptic symptoms and careful examination often leaves one unable to say definitely whether appendicitis, gall-stones, or purely stomach disturbance is present.

Bright's disease will often confuse the physician. Loss of appetite, emaciation, anemia, vomiting, and stomach analysis will closely follow the ulcer or cancer type of stomach trouble. Repeated examinations of the urine may be necessary. A history of increased frequency, together with the condition of the heart and blood-vessels, will usually clear up the diagnosis.

Pernicious anemia is often most difficult to differentiate from ulcer and cancer. Unless the blood-findings are positive one is often at a loss in deciding. There may be lack of appetite in both. Dyspeptic symptoms, but not the dislike of food, come with anemia. We do not usually find the pain and vomiting of cancer. In cancer and anemia there may be pain, shortness of breath, and palpitation on exertion, which conditions are more marked in anemia than in cancer. Rest gives perfect physical ease in anemia, while in cancer the stomach distress and general weakness do not yield completely to quiet. There is less emaciation in anemia; the skin is more apt to be a lemon color than colorless; there is an oilier "feel" present; and a slight general edema is usually found. Stomach analysis in pernicious anemia is misleading, and if seriously considered, many mistaken diagnoses may be credited to it. The absence of hydrochloric acid and the presence of blood are quite frequent conditions in both. The examination of the blood is invaluable. In anemia the hemoglobin is low, the red count low, and the color-index high. In cancer the hemoglobin test is frequently high, due to dehydration of the blood; and the color-index is not abnormal. Staining the blood, with the discovery of the distinctive cells of anemia, will usually establish the diagnosis. The facial expression is of value. In anemia there is general paleness and icteric tinge—not the excessive paleness about the eyes and nose. There are a slight puffiness of the tissues and a more hopeful expression; emaciation is less marked, and the wrinkled condition, which in cancer adds so much to the picture of cachexia, is wanting.

ABSENCE OF HYDROCHLORIC ACID, WITH BLOOD IN THE STOMACH SECRETION (ACHLORHYDRIA HÆMORRHAGICA GASTRICA), AS A SYMPTOM OF CHRONIC GASTRITIS*

By JAMES TAFT PILCHER

The purpose of the present communication is to describe a condition which has been encountered many times among the cases of stomach disease which have presented themselves for treatment at St. Mary's Hospital during a period of one and a half years, all of whom have been personally examined by me. In making these examinations, some 4000 stomach extracts after an Ewald test-meal have been analyzed. Of this entire number I can recall only seven to which the term "achylia gastrica" might be applied, and there was but one case of real insufficiency of the pylorus, which was determined at operation. On the other hand, the absence of free hydrochloric acid, accompanied by occult blood, was observed in 271 instances, or approximately one in every fifteen stomachs examined.

In various instances every gradation between normal acidity and achlorhydria has been observed, and in yet other cases it has been possible to watch the gradual return from a condition of achlorhydria hæmorrhagica back to regained normal acidity.

The anamnesis developed the fact that in 156 of the 271 cases of achlorhydria the onset of the gastric symptoms seemed to bear an immediate and direct relation to various diseases and conditions, among which the incidence of infectious diseases in 38 cases, circulatory disturbances in 12, postoperative development in 14, and derangement of the ductless glands in 20 instances deserve mention. In contradistinction to these etiologic factors determined clinically, it is very significant that in 100 cases an operation was performed while a condition of achlorhydria hæmorrhagica gastrica was present. The gross pathologic findings in these showed involvement of the appendix in 36 cases, the gall-bladder in 32 cases, the gall-bladder and pancreas in 16 cases, the stomach in 16 cases. There were 12 cases in which the appendix was diseased concomitantly with the gall-bladder.

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* Read before the American Gastro-Enterological Association, St. Louis, Mo., June 6, 1910.

Appreciating generally the extraordinary degree of gastric disturbance which irritation in distant organs can produce, it may be considered even more than a presumptive conclusion that reflex nervous phenomena are responsible primarily for the inhibition of the production of hydrochloric acid in these cases.

The morbid anatomy of the stomach and pylorus in these cases is also of interest. Sixty-four were apparently normal. In 24 pylorospasm was demonstrated on the operating table, accompanying appendicitis 18 times, and gall-bladder involvement 6 times. There were 4 cases in which Mayo deemed it advisable to cut off former gastro-enterostomies done elsewhere, there being no pathologic indication for their continuance. In two cases ulcer of the stomach was found, in one pyloric insufficiency, in three the pylorus was markedly thickened, there was one congenital stenosis, and one hour-glass contraction.

Regarding the pathology of the stomach mucosa in cases which do not show any free hydrochloric acid, it would be well to consider the study made by Wilson and MacCarty of 230 stomachs resected by Mayo for carcinoma.* In the majority of these hydrochloric acid was absent, yet in none of them was a general atrophy of the mucous membrane found. On the other hand, there was present almost without exception a marked proliferation of the mucous membrane at the margin of the ulcer. There is, however, usually an accompanying round-cell infiltration of a greater or less degree of the submucosa.

* "Am. Jour. Med.," vol. cxxxviii, No. 6, Dec., 1909, No. 453, p. 846.

In considering the similar derangement of the gastric secretion in cases in which no carcinoma is present, I have obtained specimens from three stomachs exhibiting this phenomenon. The most noticeable findings are the occurrence in each of unquestionable non-contiguous erosions or ulcerations of the mucosa (Fig. 38) in places down to the muscularis, and a very evident submucosal infiltration of round cells (Fig. 39). Further, in many situations there was a marked engorgement of the capillaries, apparently due to the inflammatory reaction. Lying irregularly over the epithelium were masses of yellowish blood-pigment, which are not found in normal stomachs, as was shown by many controls, and I feel justified in suggesting that they are probably due to a precipitation of the ferruginous element contained in the serum, which it is evident from analogy must exude from the eroded and inflamed areas.

The explanation of the entire *modus operandi* may be found in considering the following facts, which seem to have been fairly well established, and their correlation demonstrated.

First, a primary inhibition of the hydrochloric acid (reflexly produced?); second, an invasion of the stomach by pathogenic organisms, especially streptococci, causing irritation of the mucosa; and third, a superficial ulcerated erosion of the mucosa.

Calling to mind evidence tending to prove the above, we have to consider.

First, inferentially:

1. Food causes pain, the acids being the worst.
2. Relief by vomiting, lavage, and alkalies.
3. Restoration of hydrochloric acid after operation and treatment.
4. Disappearance of blood from test-meal after treatment.
5. Complete disappearance of gastric symptoms after removal of irritant (appendix, gall-stones, etc.).
6. Various progressive and retrogressive phases as indicated previously.

Second, objectively:

1. Absolute evidences of strong reflexes (pylorospasm).

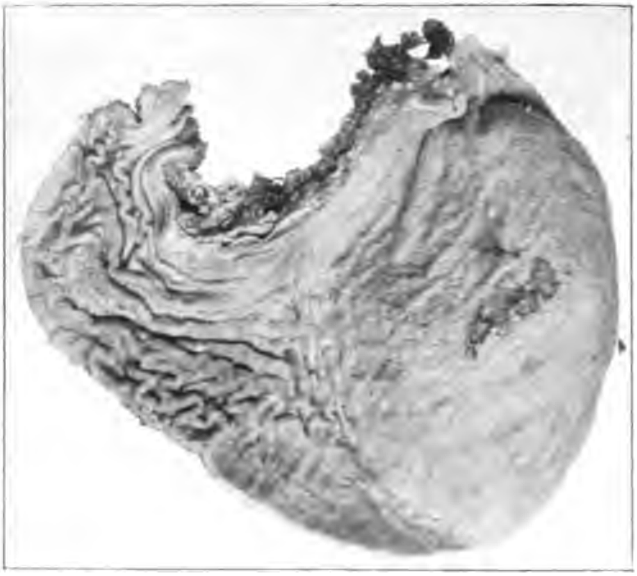

Fig. 38.—Gross appearance of posterior wall of stomach, showing non-contiguous erosions or superficial ulcerations in fundus.

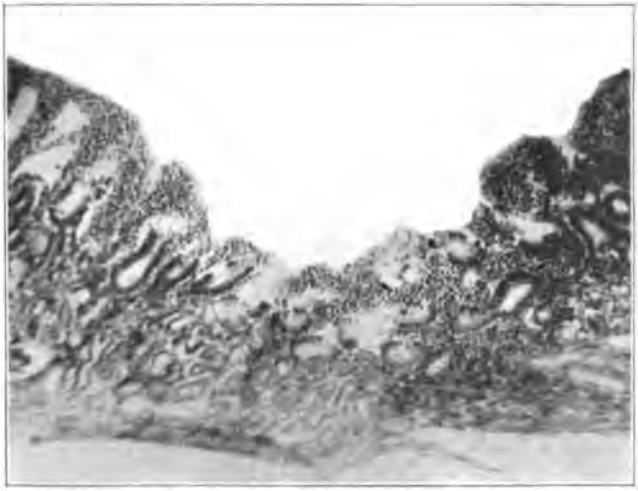

Fig. 39.—Photomicrograph through defect in mucosa in Fig. 38, showing destruction of epithelium and round-cell infiltration of submucosa.

2. Presence of micro-organisms (streptococcus, diplococcus, colon bacilli).
3. Absence of same in cases of normal acidity.
4. Normal gross appearance of these stomachs.
5. No thickening, cicatrices, or atrophy when palpated.

Third, pathologic:

Macroscopic and microscopic demonstration of erosions of mucosa and round-cell infiltration of submucosa.

Bacteriology.—In 350 specimens from 150 of these stomachs, stained at various intervals of time, the following organisms were found present with the indicated frequency:

Streptococci	127 cases
Colon alone	8 cases
Streptococci and colon	64 cases
Diplococci (marked)	84 cases
Lactic acid bacilli	42 cases

Staphylococci, proteus, and leptothrix were always present. In several instances the cells of the mucosa itself had taken on phagocytic properties. Degenerated leukocytes were almost always present, in quantities large enough to be designated as pus in 48 cases. These findings have been amply controlled by repeated observations of the flora existing in cases of hyper-, normal, and hypo-acidity, and in malignant and non-malignant stenoses, with the result that the following conclusions seemed to be indicated:

That in the stomachs of patients presenting the symptom of achlorhydria hæmorrhagica there is present a very large number of bacteria. Varieties ordinarily pathogenic are almost universally found, either alone or in combination.

That their presence is dependent upon the lowered acidity of the gastric juice.

That they are actively growing bacteria, evidenced by their profusion, morphologic characteristics, and staining properties.

That the streptococci are probably the most important factors, since they are found in larger number in those cases where pus has been noted.

That this would seem to be proof of some active irritation which would also account for the inferred presence of erosions of the mucosa.

The erosions of the mucosa are further indicated by the pain complained of.

The yellow color in the extracts and the blood-reaction must both apparently be due to the oozing or seeping of serum from these erosions.

The sour, bitter, acrid eructations are the result of the formation of organic gases.

Diagnosis.—The determination of the presence of this symptom can, of course, only be made with accuracy by an analysis of the stomach-contents, and this is quite characteristic either when considered grossly, chemically, or microscopically.

The amount recovered is usually less than that ingested. The bread is in a very coarse state of division, and practically as it has been swallowed. There is a uniform absence of viscosity, but the bread is quite frequently incorporated in thin mucus.

The color varies from a yellow tinge just off the white to a light orange. There is occasionally a slightly rancid odor.

The filtrate is invariably crystal clear and may have a slight yellowish tinge.

The total acidity varies between 6 and 8, and is due to the acidity of the ingested bread. Free hydrochloric acid is never present. Combined acids are practically negative. Traces have, however, occasionally been found.

Lactic acid is present in about 15 per cent. of the cases, but the Strauss method must be used, as by Uffelmann's method a perfect reaction is nearly always obtained, due to the lack of masking by hydrochloric acid.

The blood-reaction is always present, the guaiac test in a modified form being employed. It is always of the so-called "occult" variety, and never traumatic. If it were, the extract would be red, and it would not be an admixture or diffuse. This reaction has been amply controlled in order to convince myself that the title proposed in this paper was justified.

Remnants are seldom found, and if obtained are due to continuous pylorospasm.

I have found the biuret reaction present in a much greater percentage of cases than other observers.

Symptomatology.—The symptom-complex in this class of cases presenting the symptom of achlorhydria hæmorrhagica gastrica is rather difficult to define, chiefly because of the inconstancy of the accompanying symptoms, and yet it is on this very capriciousness that the chief point in diagnosis must be based.

The majority of these patients complain of oppression or distress in the epigastrium, amounting usually to a sensation of pain. In most cases it is of a burning or gnawing character, and occurred in one-third of the cases immediately *post cibo.* This does not always obtain, as they will say at times it occurs much later, or even before meals. The expression "at any time" is a familiar one, until they are restricted to state the inception more definitely. It is usually increased by taking food, although it may be relieved, temporarily. Various methods for its more permanent relief are to be noted, vomiting being the most prominent. Belching, and sour, bitter, acrid eructations are a very constant accompaniment.

In at least one-half of the cases vomiting is complained of, usually immediately *post cibo*, consisting of the ingesta, which has a sour, bitter taste. Nausea is not infrequent, and hematemesis has occurred in several instances. Constipation is usual, but this may alternate with periods—usually of one to four weeks—of diarrhea, while in one class of cases the imperativeness of bowel movement immediately after eating is very suggestive of this derangement.

There is usually discrimination used by these patients as to the quality and quantity of food eaten, meats and fats being the first to be discarded. Very marked impairment of the appetite is present in many instances, although here also vagaries are to be noted. The loss of weight, averaging between 15 and 25 pounds, is an almost constant finding.

Generally patients with achlorhydria present a perverted mental attitude, and have periods of depression alternating with nervous excitement. All these factors I am inclined to think are rather the result of the condition, due to the continued thought exercised by many of the so-called "dyspeptics" concerning their stomachs, or the fear induced by the idea of cancer being present, than a causative factor of the condition itself, which seems to be explicable on a much sounder pathologic basis than that of a neurosis. Malaise, easy fatigue, inability to work, occasional headaches, and insomnia complete in a general way the symptomatology presented by the majority of the cases in this series.

Among the conditions which must be differentiated are gastric and duodenal ulcer, cancer and cardiospasm, also pregnancy, uremia, phthisis, urokinetic conditions, chronic obstruction of colon, diseases of the nervous system, tabetic crises, hysterical vomiting, angina pectoris, abdominal angina, and mucomembranous colitis. The relative value of each I hope to demonstrate in a subsequent article.

The coexistence of the etiologic factors (cholecystitis, appendicitis, pancreatitis, etc.), with their more or less obvious symptomatology, must be taken into consideration primarily.

Treatment.—This resolves itself into either medical or surgical. The latter is certainly indicated when any pathologic condition can be determined upon. In view of our inability to diagnose any etiologic factor, the best results have been obtained from proper regulation of the diet and from the employment of the alkalies in combination with general tonics.

Of the cases considered, 172 have been traced and their personal statement of their present condition tabulated. Sixty-one cases have entirely recovered, 38 have merely an occasional complaint, 23 feel comparatively well, 9 are moderately improved. In 26 there was no improvement, while 4 were worse, and 11 had died.

The greatest improvement has been obtained in those operated upon. Of the 11 recorded as dead, we find the cause given usually of the primary factor, as pancreatitis, nephritis, myocarditis, pernicious anemia, etc. One I know developed a cancer in the stomach, and two gave a history very suggestive of it, but it could not be confirmed.

Summary.—There is a definite entity presented in the stomachs of some patients suffering from various intra- and extra-abdominal pathologic conditions, which is characterized by the absence of hydrochloric acid and the presence of "occult" blood.

This condition is probably effected through the agency of a reflex nerve stimulation inhibiting first the production of free hydrochloric acid to only a moderate degree.

This so modifies the inhibiting factor of the gastric juice that the necessary conditions for the growth of pathogenic bacteria are furnished, chief among which are to be reckoned the streptococci and colon group, which are present in striking numbers.

These direct irritants, either themselves or in conjunction with a primary irritative factor, *e. g.*, gall-stones, appendicitis, pancreatitis, etc., perpetuate the pathologic process until there is an achlorhydria produced.

It is most probable that to the ulcerative erosion following this irritation the presence of blood may be ascribed.

In the 100 stomachs examined at operation, atrophy was never present, nor was there, except in one case, any evident insufficiency of the pylòrus.

There is a general symptomatology accompanying this condition which is very suggestive.

The test-meal recovered is indicative of the pathologic process in the stomach.

There were indications in but seven cases observed that there was no secretion from the stomach mucosa. In others the presence of mucus, the biuret reaction, and coagulation after activation would tend to show that there was still a moderate degree of enzymotic action. The cases are therefore not "achylia gastrica."

Proof of the etiologic factors has been demonstrated in the cases operated upon, deduced from their prompt and permanent recovery.

The condition is so common, approximately one in every fifteen stomach cases examined, and the indication it gives of irritation in other organs I believe so firmly established, not to mention the potential factor to cause future trouble which it itself contains, that it merits more frequent consideration in the study of possible gastric conditions.

CLINICAL EXPERIENCES WITH THE CAMMIDGE REACTION*

BY BYRD CHARLES WILLIS, BERNARD FRANCIS McGRATH, JAMES TAFT PILCHER, AND DONALD CHURCH BALFOUR

UNDER THE DIRECTION OF
LOUIS BLANCHARD WILSON

The first work of any considerable extent on the Cammidge reaction in the laboratory of St. Mary's Hospital was that done by Balfour two years ago on 80 cases, following closely Cammidge's technic. This was very discouraging in results, and was given up largely because "positive" reactions were obtained frequently on apparently normal individuals.

The examinations were resumed by Pilcher in May, 1909, principally on cases showing more or less symptoms of pancreatic involvement. An effort was made to improve the technic by running parallel tests of hydrolyzed and unhydrolyzed specimens. The cases were studied clinically by Pilcher at the time of making the tests, after the manner described by Cammidge. They were also seen by Pilcher at operation. The results, which have been published elsewhere,† appeared on their face to warrant further study of the test as an aid to clinical diagnosis. Thus of 62 patients at operation showing involvement of the pancreas, 50 gave more or less "positive" reactions; of 50 cases showing at operation no pancreatic involvement, 7 gave more or less "positive" reactions; and of 25 "well" individuals, 1 gave a "positive" reaction. There was a feeling on the laboratory staff, however, that there were great possibilities of error in this method of working, not only owing to the indefiniteness of what actually constituted a reaction, —due to great variation in color changes, amount of precipitate, type of crystals, relation of controls, etc.,—but also to the difficulty of eliminating bias in judgment when the laboratory technician was familiar with the clinical history of the case under consideration.

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* Read before the Association of American Physicians, Washington, D. C., May, 1910. (Reprinted from "Surgery, Gynecology and Obstetrics," Aug., 1910, pp. 156–159.)

† "Annals of Surgery," 1910, vol. li, pp. 88–109.

On January 6, 1910, Willis and McGrath therefore took up the study along with Pilcher, seeking first to attain a uniform technic; second, to analyze the types of reaction; and, third, to eliminate the personal equation by having the end-reactions classified by one (Pilcher) who knew nothing of the patient.

The cases were clinically of four classes: (1) cases shown at operation or autopsy to have involvement of pancreas; (2) cases (with abdominal or pelvic lesions) which at operation or autopsy were shown to have no involvement of the pancreas; (3) sick individuals in whom the pancreas was not examined; and (4) apparently well individuals.

Technic.—The specimens of urine were twenty-four-hour, or mixed evening and morning collections. These were sent to the laboratory in well-stoppered bottles immediately after the last portion of the specimen was collected. The specific gravities and reactions were taken. The specimens were then filtered through double filter-papers into two beakers, graduated for 40 c.c., and 5 c.c. was taken to test for albumin and sugar tests. For the latter, two parts of urine to one of Fehling's solution was used, heating both separately, and then pouring together and allowing to stand.

When a trace of albumin was found, the specimens were acidified with dilute acetic acid, boiled, and refiltered.

If the specimen was alkaline (very few), it was acidified with dilute acetic acid.

In making the Cammidge tests proper all glassware was thoroughly rinsed and all filter-papers were well moistened with distilled water. The two 40 c.c. samples of each urine were numbered. To the specimen to be hydrolyzed was added 2 c.c. c. p. HCl, sp. gr. 1.20 (Grasselli). The specimen was gently boiled on the sand-bath for ten minutes, with recondensing funnels in place, then transferred into racks to cool in running water. At this point, when necessary (seldom), distilled water was added to bring the amount up to 40 c.c. Eight grams of pure lead carbonate (Mallinckrodt's) was slowly added to the specimen, which was thoroughly shaken, and was then allowed to stand five or ten minutes for completion of neutralization. It was passed through double moist filter-papers until perfectly clear. The unhydrolyzed control without previous preparation was from this point run parallel to the hydrolyzed. Eight grams of pure tribasic lead acetate (Merck) was added slowly to each specimen, which was then well shaken and allowed to stand from ten to fifteen minutes, and then filtered through double moist filter-papers until clear. To each 4 grams of pure sodium sulphate (Mallinckrodt) was now added, and the specimens brought to a boil on a sand-bath, then cooled in running tap-water, and filtered through moistened filter-paper. To 10 c.c. of the clear filtrate were added successively 1 c.c. 50 per cent. acetic acid, 7 c.c. distilled water, 2 grams pure sodium acetate (Mallinckrodt), and 0.8 gram phenylhydrazine hydrochlorate (Merck). The specimens were then boiled for ten minutes on the sand-bath. Lastly the specimens were filtered hot, through filter-paper moistened with hot water, into test-tubes. Owing to the use of funnel recondensers the final amounts were uniformly approximately 15 c.c. The tubes were then set aside at a temperature of about 5° C.

For accuracy of results and convenience in handling large numbers of specimens at once, tall beaker glasses (capacity 170 c.c., height 11 cm., diameter at top 5 cm.) were used. A copper water-bath (64 cm. in length, 33 cm. wide, 6 cm. deep, and containing in cover 32 circular apertures 5 cm. in diameter) was used for cooling the solutions in beakers. A reinforced sheet-iron pan with wire-rack cover was used for a sand-bath, and gave very uniform heating. From eight to fifteen specimens (*i. e.*, 16 to 30 tests) were carried through at one time by two men working together, one analyzing the specimens to be hydrolyzed, and the other the controls. To facilitate the work four sets of glassware were prepared in advance. All chemicals were carefully weighed in sets at the same time. When once the analyses were begun, they were pushed to completion as rapidly as possible, it usually requiring about three hours to complete a day's tests. In addition to the above, no pains were spared to make the tests as uniform as possible, even in the most minute detail.

PRELIMINARY TESTS

1. *Sugar.*—In doing the Fehling's test for sugar a careful record of the colors was kept after the tubes had stood several hours and three groups were adopted:

1. Bluish color: 48 tests, 22 of which in the Cammidge test had some form of crystal in either or both of the hydrolyzed or unhydrolyzed specimen. Thirteen of the 22 crystalline end-reactions were "positive" Cammidge reactions.
2. Greenish color: 252 tests, 197 of which in the Cammidge test had some form of crystal in either or both, of the hydrolyzed or unhydrolyzed specimen. Seventy-four of the 197 crystalline end-reactions were "positive" Cammidge reactions.
3. Reddish color: 206 tests, 188 of which in the Cammidge test had some form of crystal in either or both of the hydrolyzed and unhydrolyzed specimen. Seventy-four of the 188 crystalline end-reactions were "positive" Cammidge reactions.

There were 23 urines which gave Fehling's reaction for sugar, 7 of which gave positive Cammidge crystals. A number of the sugar specimens were fermented for twenty-four hours with yeast, and in no case was a crystal obtained subsequently by Cammidge test. A number of urines (same specimens) that had given what were considered most typically positive Cammidge reactions were fermented with yeast for twenty-four hours, and subsequently tested for Cammidge crystals. None whatsoever found.

2. *Specific Gravity.*—The apparent relationship of the specific gravity and the Cammidge end-reactions is shown in the following table:

Specific Gravity.	Number of Cases.	Results of Cammidge Tests.
1025–1039	208 (88 positive)	42.3 per cent.
1015–1024	239 (66 positive)	27.6 per cent.
1001–1014	56 (12 positive)	21.4 per cent.

3. *Cammidge End-reactions.*—As soon as the decision as to what constituted a positive end-reaction was made to rest solely on the contents of the test-tubes it became evident that the diagnostician with the greatest experience (Pilcher) was frequently unable to decide the value of the various colors, precipitates, and crystals, while others with less experience were wholly at sea.

An effort was made therefore to analyze and classify the various factors of the end-reaction in order not only to have some uniform nomenclature for recording our observations but also to determine what valuation should be placed on each variant. With this in view the following nineteen types of hypothetic end-reactions were adopted:

VARIETIES OF REACTIONS IN CAMMIDGE'S "C" TEST

Examination of tubes made after standing eighteen to twenty-four hours, at about 5° C.

Variety	End-reaction of HCl Specimen	Diagnostic Significance	End-reaction of Control	No. End-reactions in Each
1	No change	Negative	No change	95
2	Orange color only	Very doubtful	No change	4
4	Amorphous precipitate	Very doubtful	No change	2
5	Amorphous precipitate	Very doubtful	Amorphous precipitate	2
6	Amorphous precipitate	Very doubtful	Atypical crystals	10
7	Atypical crystals	Doubtful	No change	37
8	Atypical crystals	Doubtful	Amorphous precipitate	17
9	Atypical crystals	Doubtful	Atypical crystals	113
10	Typical crystals	"Positive"	No change	21
11	Typical crystals	Very suspicious	Amorphous precipitate	7
12	Typical crystals	Very suspicious	Atypical crystals	72
14	No change	Negative	Amorphous precipitate	6
15	No change	Negative	Atypical crystals	42
16	Orange color	Doubtful	Atypical crystals	1
17	Typical crystals	Very suspicious	Typical crystals	61
18	Atypical crystals	Negative	Typical crystals	11
19	No change	Negative	Typical crystals	3
				504

Two of these types of hypothetic end-reactions (Nos. 3 and 13) were found not to occur, and they have been purposely omitted in the preceding table.

As nearly as can be determined from Cammidge's somewhat indefinite description of his end-reaction probably four—Nos. 10, 11, 12, and 17—of these types would be (by him) considered positive and the remainder negative.

On this basis, in which we have followed Cammidge as accurately as possible, the results of our 504 tests may be analyzed as follows:

Group 1.—Patients with Pancreas Involved: In this group there were 26 cases, 17 of which were examined before operation. Of these, 6 gave positive reactions. Of the same 26 cases examined five days after the operation, 6 were positive, 3 of these having been positive before operation, 1 negative, and 2 not previously examined. Twenty-four of these cases were examined about the ninth day after operation, and 3 gave positive reactions. These 3 had all been positive at the examination before operation. One had been positive on the second test, and the other two negative.

Group 2.—Patients with Pancreas not Involved: In this group, containing 74 cases, 26 were examined before operation. Of these, 16 were positive. Five days after operation all 74 were again examined, and 21 were positive. Four of these had been positive before operation, 2 had been negative, and the remaining 15 had not been previously examined. About nine days after operation 69 of these cases were again examined. Seventeen were positive. Of these, 5 had been positive before operation, 1 had been negative, and the remaining 11 not examined before operation. Twelve of the 17 cases had been positive five days after operation.

Group 3.—Sick Persons Whose Pancreases Were not Examined, but Who Exhibited no Recognizable Symptoms of Pancreatitis: In this group 207 cases were examined. Seventy-three of these were positive. Of these 73 positives, 17 were goiter cases (44 goiter cases in all being examined), 9 were appendicitis cases, and the remainder were cases of salpingitis, uterine tumors, etc.

Group 4.—Apparently Well Persons (Members of the Hospital

Staff): In this group 17 cases were examined from one to five times each. Of these, 5 were positive.

It will thus be seen that of the 26 patients who were shown to have pancreatitis (Group 1) only 9 (35 per cent.) gave a positive reaction, and, even of these, 7 in one or more of the series of three tests gave negative results. Of the 74 sick persons without pancreatitis (Group 2), 35 (47 per cent.) gave one or more positive reactions. Of the 207 sick persons who in all probability had no pancreatitis (Group 3), 73 (35 per cent.) were positive. Of the 17 well persons, 5 (30 per cent.) were positive.

SUMMARY

From the foregoing it is apparent:

1. That even where the most elaborate care is exercised to follow the technic of Cammidge's "C" reaction, in the most uniform manner, *if knowledge of the clinical histories and other factors of the personal equation be eliminated,* the end-results, judged by Cammidge's own criteria, must be considered, as a means of diagnosing disease of the pancreas, as both valueless and misleading.

2. There is no apparent clinical relationship between disease of the pancreas and any of our various types of end-reaction.

3. It does not seem to us that the end-reactions are artifacts, but rather that they indicate actual metabolic variations. The relationship of these changes in metabolism to the welfare of the patient is not apparent.

GASTROJEJUNAL ULCERS (PSEUDOJEJUNAL ULCERS)*

By WILLIAM J. MAYO

The writer has made an investigation of all the cases in which gastrojejunostomy has been done in St. Mary's Hospital, to ascertain, if possible, if jejunal ulcer has occurred as a secondary condition.

The total number of operations performed upon the stomach and duodenum up to December 31, 1909 (C. H. and W. J. Mayo), was 1,775. Of these, 1,141 were gastrojejunostomies. In 715 cases the operation was for duodenal and gastric ulcer, in 167 cases for cancerous obstruction at the pylorus, and 259 were in connection with partial gastrectomy. The large majority of the latter operations were for malignant disease.

Of the whole number, so far as any knowledge could be obtained, not a single case developed true jejunal ulcer; nor have any such cases come to our clinic in which gastrojejunostomy had been performed by other surgeons.

It must be admitted that we might not have recognized a jejunal ulcer had we found one, and it is possible that some of the cases in which symptoms continued after operation were due to an undiagnosed jejunal ulcer. It is also possible that some of our patients may have fallen into the hands of other surgeons who have found the ulcers and operated for this secondary condition.

Acid gastric secretions when diverted into the jejunum (in connection with lowered local resistance) are undoubtedly the active causes of peptic ulcer, but we should remember that the jejunum is continuously bathed in the alkaline pancreatic and biliary secretions, and that the jejunum is, therefore, much better protected than the stomach and upper duodenum where peptic ulcer ordinarily appears.

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* Reprinted from "Surgery, Gynecology and Obstetrics," March, 1910, pp. 227–229.

Herbert J. Paterson* has made a most important contribution to the subject of jejunal ulcer. He tabulates in detail the fifty-two cases recorded, reporting one typical case of his own. Paterson points out, however, that "nearly one-third of the reported jejunal ulcers involve both the stomach and jejunum." They were found in the line of anastomosis and were, therefore, gastrojejunal, although originally classed as jejunal ulcers. He says: "Jejunal ulcers are the result of altered physiologic conditions produced by operation; gastrojejunal ulcers are probably a direct consequence of operation." I quite agree with Paterson that the latter cases should not, without qualification, be grouped with jejunal ulcers, but should be classified separately as "gastrojejunal ulcers." I believe that we should view most gastrojejunal ulcers as due to technical failures in the operation itself rather than as an unavoidable condition, which, up to the present time, true jejunal ulcer appears to be.

We have had three cases corresponding to the gastrojejunal or pseudojejunal type of ulcer. A brief report of them is appended herewith.

CASE 1.—St. Mary's Hospital records. May 5, 1899. *Gastrojejunal ulcer, result of impacted button.* Female, aged thirty-eight. Married eleven years. Three children, youngest four years. Menses absent for seven months. Has lost over 20 pounds in weight. History for several years of "spells of stomach trouble" in periods lasting from a few days to a few weeks and marked by acid eructations and a burning feeling when the stomach is empty, especially several hours after taking food. Vomiting frequent for the past two years, and for several months the act has been induced once or twice a day to empty the stomach of its contents. The vomitus contains much partially digested food; no blood.

Present condition: Emaciated woman presenting no evidences of disease outside of the stomach. The stomach greatly dilated and somewhat prolapsed, its lower border extending downward nearly to the pelvic brim. The contents of the stomach were withdrawn with a tube and contained a great quantity of fermenting foodstuff with a musty odor.

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* "Annals of Surgery," August, 1909.

Diagnosis: Pyloric obstruction. Operation May 7, 1899. A calloused ulcer was found obliterating the pylorus and reducing its caliber to about that of a lead-pencil. Anterior gastrojejunostomy with the Murphy button was performed. Button not passed.

Subsequent history: Patient gained over 30 pounds in weight; felt quite well and was able to attend to her household duties until three years and nine months after operation, when she had a sudden attack of abdominal distress supposed to be appendicitis. This was followed at once by symptoms of obstruction and constant interference with the progress of food from the stomach. A tender mass was palpated just to the right of the umbilicus. Operation April 2, 1902. A mass of adhesions attached to the abdominal wall was encountered about an ulcer which had perforated the stomach immediately above and to the right of the original gastrojejunostomy opening. The ulceration began at the site of the stroma, the jejunal mucous membrane forming the lower border of the ulceration. The button was found in the stomach somewhat corroded. When passed downward into the site of the gastrojejunostomy, the button was seen to fit closely into the site of the ulcer. Evidently the acute symptoms were due to the button dropping into the opening, producing obstruction and a pressure ulcer. It was noted during the operation that the button became dislodged with the manipulations. The ulcer was excised and a large plastic gastrojejunostomy done over a Robson bone bobbin. The patient recovered and has remained well.

Case 2.—St. Mary's Hospital records. January 22, 1904. *Gastrojejunal ulcer the result of retention of infected suture material.* Male, aged fifty-four. Came for examination seven months subsequent to a gastrojejunostomy performed by a competent general surgeon in a distant city. History for past twenty-four years: Dyspeptic; better and worse by spells but gradually losing ground. Gas eructations, burning distress in the stomach eased by taking food, alkalies, or diluents. Gastrojejunostomy seven months ago which gave temporary relief, but was followed by more pain and tenderness and occasionally bile vomiting. Pain different in character and seemingly located to the left of umbilicus. Cicatrix of former operation in midline between umbilicus and ensiform cartilage. Stomach splashy, prolapsed, but evidently protected by the abdominal muscles against sudden motion. Acids normal, but some food remnants found in gastric contents after five and one-half hours. Small quantity of bile present.

Operation January 28, 1904. Incision 2 inches to the left of the midline. Dense adhesions encountered. Site of gastrojejunostomy exposed; a posterior operation on a 9-inch loop. On the anterior margin of the gastrojejunostomy a thickened spot was discovered covered by recent adhesions and having the appearance of a perforation, evidently the cause of the general abdominal adhesions previously encountered. The stomach was opened just above this point, close to the line of the gastrojejunal union, exposing an ulcer with a thickened base in the line of union. The ulcer was about 1 cm. in diameter and undermined at the inner side. The floor of the ulcer was hard and smooth, but just at the point of undermining a projection was seen which proved to be a silk suture in communication with the gastro-intestinal cavity. The suture was removed, the ulcer excised, and a large plastic gastrojejunostomy done at the site of the opening. A suture entero-anastomosis between the limbs of the jejunum was then done and the pyloric ring excised, the stomach and duodenal ends turned in. The patient made a rapid recovery and when last heard from, two years after the operation, was in good health.

CASE 3.—St. Mary's Hospital records. March 10, 1907. *Gastrojejunal ulcer, the result of infected hematoma in the suture line.* Male, aged thirty-four. Fourteen years ago began to have spells of stomach trouble, pain, gas, sour eructations, heartburn two to six hours after meals, eased by taking food. No vomiting. A year ago he became much worse. Epigastric tenderness and attacks of severe pain at irregular intervals, radiating to the right. In May, 1906, an exploratory operation for gall-stones was done by his home physicians; no stones found. He has been taking morphin daily for more than a year. Lost 40 pounds in weight.

Physical examination: Emaciation marked. Urine contained small amount of albumin and a few casts. Except for stomach symptoms, patient normal. Stomach moderately dilated. Test-meal shows total acidity 94; hydrochloric 70; combined 20. *Diagnosis:* Duodenal ulcer.

Operation March 18, 1907. Large duodenal ulcer; subacute perforating, protected by adhesions. Posterior no-loop gastrojejunostomy. A small hematoma was formed by the accidental pricking of a vein in the transverse mesocolon, necessitating supplemental sutures. Patient made a good recovery, gained 39 pounds in weight and stopped morphin. Re-examination November 24, 1909. For more than a year following the gastrojejunostomy he had had no further trouble except for some localized soreness to the left of the umbilicus. About three months ago this tenderness increased and was accompanied by many of the former symptoms, though less in degree. No vomiting, but constant pain. Test-meal shows total acidity 84; hydrochloric 70; combined 14. Urine, specific gravity 1,028. Acid. Hemoglobin 86 per cent.

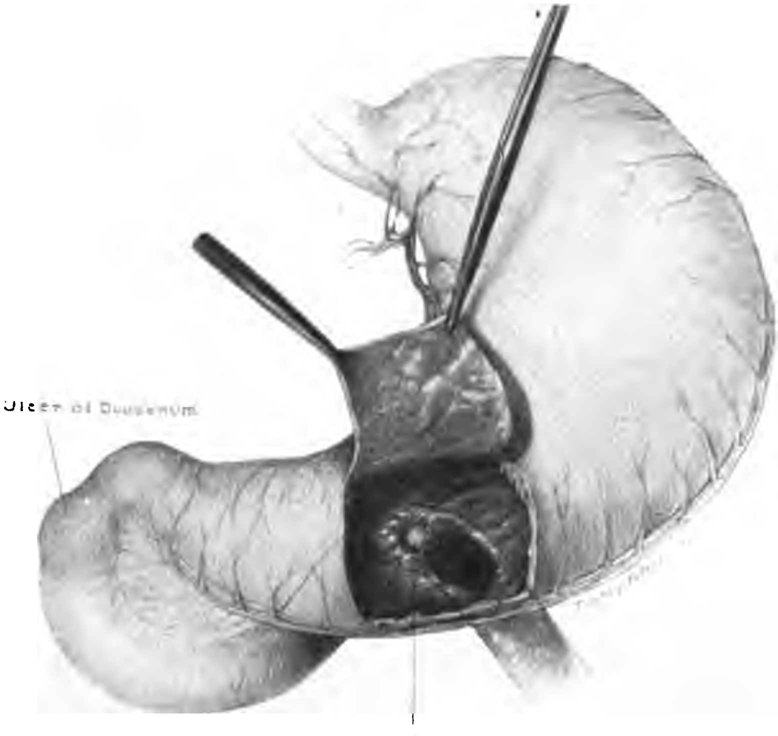

Fig. 40.—Gastrojejunal ulcer, the result of infected hematoma. (Case 3.)

Operation December 4, 1909. An ulcer was found in the line of the gastrojejunostomy opening about 1.5 cm. in diameter, extending into the fatty tissue of the mesocolon at the point of the former hematoma. The ulcer base was hard and smooth, composed of fibrous tissue and fat. The whole of the gastrojejunostomy opening, together with the ulcer, was excised and the stomach and jejunal openings completely closed. A large Finney gastroduodenostomy was done at the site of the original duodenal ulcer, which had healed and contracted down. Examination of the excised gastrojejunal ulcer showed it to be a cavity in the fatty tissue and not containing in its floor either stomach or intestinal tissue (Fig. 40).

TRANSGASTRIC EXCISION OF CALLOUSED ULCER OF THE POSTERIOR WALL OF THE BODY OF THE STOMACH*

By WILLIAM J. MAYO

Gastrojejunostomy has proved an efficient means of relief for calloused ulcers which lie in the pyloric end of the stomach and are obstructive in character; but for the considerable number of cases in which the ulcer is located at some little distance proximal to the pylorus, this operation is often inefficient, and, at best, gastrojejunostomy leaves a cancer possibility which cannot be ignored.

It has been shown by Robson, Moynihan, and others, that gastrojejunostomy, though it gives relief to symptoms, does not protect the patient from later carcinomatous degeneration.

Three hundred resections have been performed in St. Mary's Hospital (Sept. 23, 1910). Two hundred and sixty-three of this number were subjected to careful examination in order to determine in how many of the cases cancer had its origin in ulcer, and it was shown definitely that 71 per cent. of the gastric cancers had developed on gastric ulcer.

The frequency with which malignant disease develops upon gastric ulcer leads to the conviction that chronic calloused ulcer of the stomach is treated best by excision, and in excising, if mechanical conditions are created which interfere with the progress of food, gastrojejunostómy for the purpose of drainage should be done as a supplementary procedure.

For ulcers lying in the pyloric end of the stomach, the Rodman operation is efficient, *i. e.*, partial gastrectomy with complete closure of the end of the duodenum and stump of the stomach, and independent gastrojejunostomy. This procedure is a rational application to a new field of the Billroth operation No. 2 for gastric cancer, and we have used the method a number of times with great satisfaction.

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* Reprinted from "Annals of Surgery," Dec., 1910.

In saddle ulcers of the lesser curvature, excision may ordinarily be performed without difficulty, and the excision of an ulcer of the anterior wall of the stomach may be easily accomplished, but in the type of ulcers which occur on the posterior wall of the body of the stomach, which are so often adherent to the pancreas and other retrogastric structures, excision is most difficult. In several instances where there was hour-glass contraction, we have succeeded in making a resection in continuity with end-to-end anastomosis of the divided stomach ends.

There are a number of posterior ulcers, however, in which none of these operative measures can be applied satisfactorily, and in such cases we have succeeded in making a transgastric excision of the ulcer through the anterior wall of the stomach. Our first transgastric excision of a calloused ulcer of the posterior wall of the body of the stomach was the result of an immediate necessity to meet an accidental complication. A male, forty-eight years of age, was found to have calloused ulcer of the posterior wall of the stomach about 4½ inches above the pylorus. The ulcer was adherent to the pancreas, which formed the ulcer base. An opening was made through the gastrohepatic omentum, and an attempt made to separate the ulcer from the pancreas, hoping thus to bring it into view through the opening in the gastrohepatic omentum and excise it, or to perform a resection in continuity. These manipulations resulted in partially separating the ulcerated surface posteriorly, with immediate leakage of the stomach contents behind into the lesser cavity of the peritoneum. The gastric opening was plugged with a finger, the gastrocolic omentum opened below, and with some difficulty adequate protection was secured about the ulcer. It was impossible to get a view of the ulcer either from above or below, therefore the anterior wall of the stomach was opened to the extent of 3½ inches in its long axis, and by retraction of the margins of the opening, a splendid view of the ulcer was obtained. The ulcer was excised with a knife, leaving it attached to the pancreas, from which situation it was shaved cleanly off. The cut margins of the posterior wall of the stomach were sutured from the mucous side by means of a running suture of heavy linen thread applied transversely to the long axis of the gastric cavity. The anterior wall of the stomach was closed with chromic catgut and linen. An attempt was then made to apply a peritoneal suture behind to cover the row which had been applied from the mucous surface. It was quickly seen, however, that serious damage would result in an attempt to secure the necessary exposure. Further examination revealed that the single through-and-through suture which had been applied from the mucous

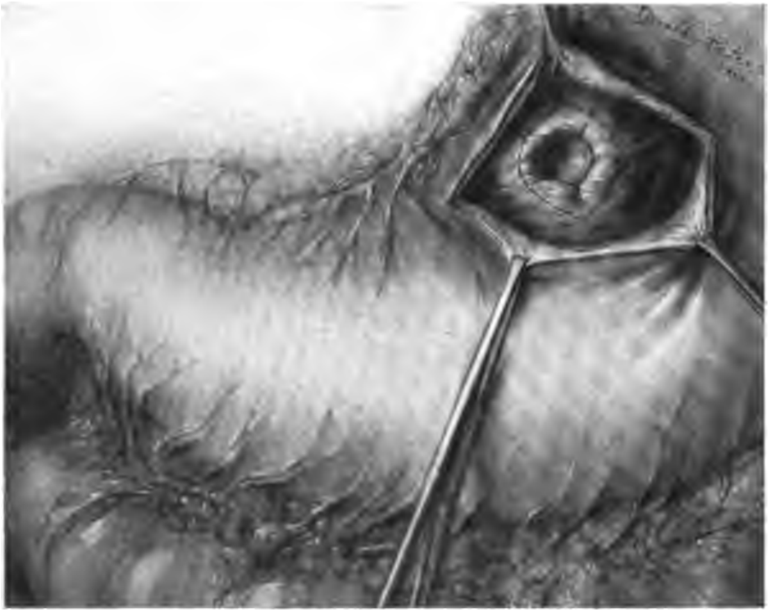

Fig. 41.—Transgastric excision of calloused ulcer of the posterior wall of the body of the stomach, showing anterior wall of the stomach open and the ulcer exposed. The dotted lines show proposed site of excision.

surface made a most satisfactory union without reinforcement. Three drains, composed of rolls of rubber tissue, were passed behind the stomach to the line of sutures to cover the site on the

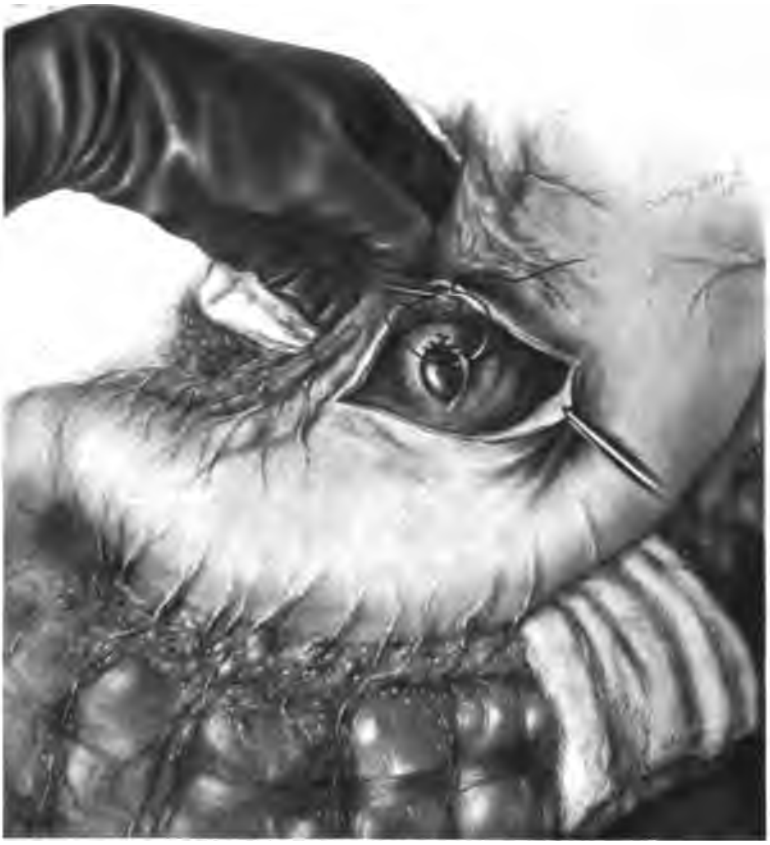

Fig. 42. - Ulcer excised, and the through-and-through mucous suture partially completed.

pancreas where the ulcer had been excised. These drains were brought out through the upper angle of the abdominal incision. There was no leakage or drainage, and the patient made a prompt and permanent recovery.

Connell, Coffey, and others have proved, clinically and experimentally, that the single suture is safe, and in the various instances in which we have applied the single through-and-through suture from the mucous surface, the result has been satisfactory.

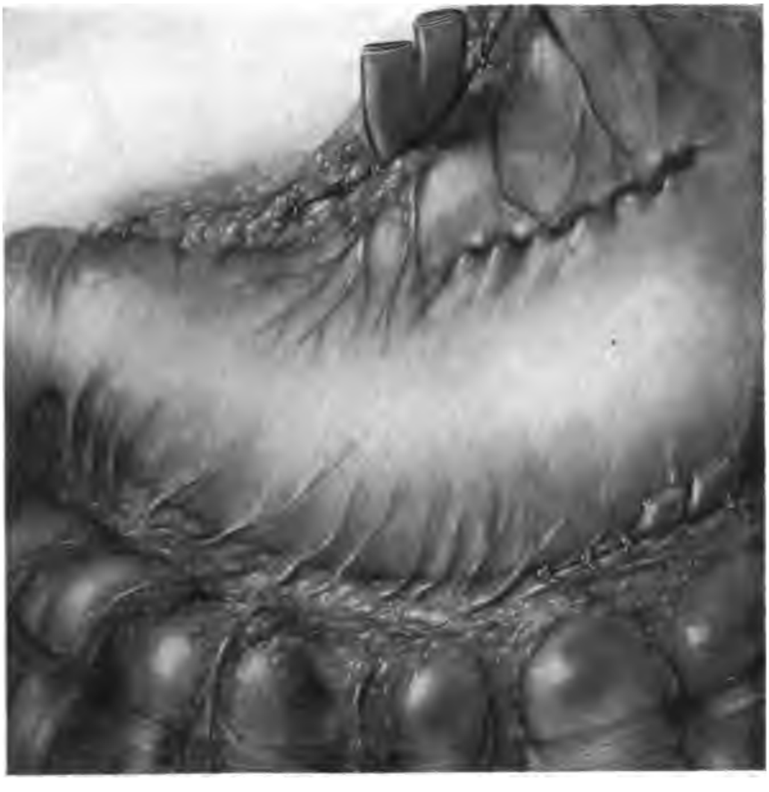

Fig. 43.—Anterior wall of the stomach sutured. Rubber-tissue drains in place.

We have performed the transgastric operation for removal of adherent calloused ulcers of the posterior wall of the body of the stomach five times, without leakage or evidences of infection, and with the recovery of the patient in each instance. The steps of the operation are as follows:

The gastrohepatic and gastrocolic omenta are opened above and below the ulcer. Gauze protection is introduced, adhesions are carefully separated, and, if possible, the ulcer surface is cut free from the posterior attachments without opening the stomach. A piece of gauze is packed into the denuded area behind, and in all but one of our cases this temporary pack was adequate to stop hemorrhage without the ligation of vessels. The anterior wall of the stomach is opened, and with the fingers behind, the entire ulcerated surface is pressed through the anterior incision and the ulcer excised (Fig. 41). The gap is sutured with through-and-through sutures of chromic catgut from the mucous side transversely, and this suture line is further protected by several mattress sutures of linen, applied from the mucous side to prevent separation due to the early absorption of the catgut (Fig. 42). The anterior wall of the stomach is then closed. Several rubber-tissue drains are carried down behind the stomach and brought out at the upper end of the abdominal wound as a safeguard (Fig. 43).

NOTE.—Since writing the above the author has learned that in May, 1907, Lewis Stephen Pilcher reported a case in the "Long Island Medical Journal," in which he made a transgastric excision of the posterior wall of the stomach in a similar manner, with a successful outcome.

PATHOLOGY AND CLINICAL SIGNIFICANCE OF GASTRIC ULCER*

FROM A STUDY OF THE MATERIAL FROM 216 PARTIAL GASTRECTOMIES FOR ULCER, ULCER AND CARCINOMA, AND CARCINOMA

By WILLIAM CARPENTER MacCARTY

In the history of the study of ulcer another period may be recorded, and that is, the observation of ulcer in the living individual as seen at operation and immediately after removal. With the improvement of legal right and individual submission to more scientific examination, trained observation, and surgical dexterity, our knowledge has increased in a systematic and orderly manner until to-day we are in a better position to confirm and add to the remarkable observations and records of Baillie, Abercrombie, Cruveilhier, Morgagni, Rokitansky, Müller, Heitler, Waldeyer, Hauser, Welch, and others in passing successively from purely autopsy findings, and autopsy and clinical findings, to the immediate examination of early ulcers during and after resection.

The cases herewith presented are a part of the material examined freshly within two minutes after removal from 216 resections of the stomach for ulcer, ulcer and carcinoma, or carcinoma, in the clinics of C. H. and W. J. Mayo.

The material divides itself grossly and microscopically into three groups. These groups comprise 216 cases, 58 of which are ulcers, 125 ulcer and carcinoma, and 33 carcinoma without any good evidence of ulcer. The last two groups will be considered in this point was tender, the soreness lasting about three days after patient was out of bed. Four years ago he had some pain and soreness, especially after exertion. About seven or eight months ago there was again tenderness over McBurney's point; it came on at 11 A. M. and 4 to 5 P. M., and continued until salty water ran out of the mouth. The patient would then vomit; the vomitus was sour and bitter; four months ago it became bloody. Three days ago a tumor was noticed in the epigastrium. His weight decreased 60 pounds. He complained of gas one to two hours after meals. Belching of this gas gave no relief. The pain often radiated to the loin. At operation three-fourths of the stomach and the lesser curvature were resected for cancer and multiple ulcers. The resected portion contains five simple ulcers and one malignant ulcer varying in size from 3 mm. to 2.5 cm. in diameter. The largest of these (Figs. 44, 45, c) ulcers is about 0.5 cm. in depth, and has a base which extends partially through the muscularis and is covered to the extent of 0.5 mm. with necrotic tissue. The next largest ulcer, which is 2 mm. in depth, does not extend to the muscularis, but rests upon a chronically inflamed submucosa, which is composed of dense scar tissue. The ulcer (*b*) is 2 mm. in depth and 6 mm. in diameter and rests upon a chronically inflamed submucosa. There is no apparent hypertrophy of the mucosa, but it does project over the edge of the ulcer cavity. The bases of the two larger

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* Reprinted from "Surgery, Gynecology and Obstetrics," May, 1910, pages 449–462.

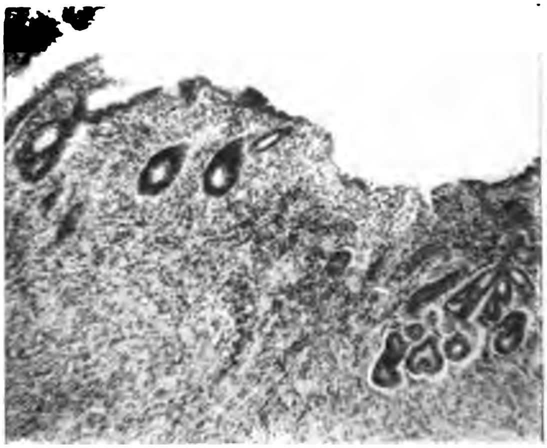

Fig. 46.—(Case No. 18088.) Microphotograph of section through ulcer (*a*), Figs. 44 and 45.

ulcers are composed of dense connective tissue, along the surface of which are found lymphocytes and necrotic connective tissue. Throughout this connective-tissue mass and extending into the mucosa are numerous aggregations of lymphocytes. There is no evidence in the mucosa of any irregularity in the glandular arrangement; however, a few of the cells of the individual glands show marked irregularity in size. These, however, cannot be said to be carcinoma. In no portion of the border of any of the ulcers is there any trace of epithelium dipping below the mucosa into the submucosa. The nuclei are apparently regular in shape and size in all areas examined, excepting the one small area described above. The smallest ulcer (Figs. 44, 45, 46) does not extend below a depth greater than half that of the mucosa. Epithelial cells or remnants of glands may be seen in the base of this ulcer. The base is composed of dense connective tissue, which extends through the mucosa and submucosa. The muscularis mucosæ is almost completely intact, with narrow strands of connective tissue penetrating it. The glands in the border of this small ulcer are regular in shape, and have nuclei which show no irregularities. The mucosa is infiltrated with lymphocytes in great numbers. One centimeter from the border of the ulcer is a definite chronic gastritis.

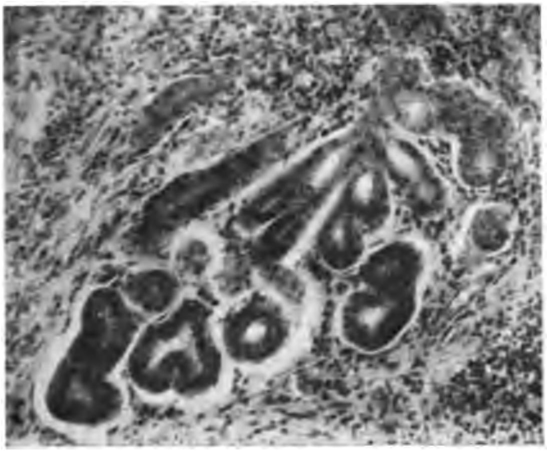

Fig. 47.—(Case No. 18088. High-power microphotograph of section through the base of ulcer (*a*), Figs. 44, 45, and 46.

In this specimen we have "erosions" in various stages, from a partial destruction of the mucosa to complete destruction of the mucosa and involvement of the muscularis. Whether or not the gastritis seen in the mucosa bordering the ulcers is secondary to the condition which caused the ulcer or is primary to the erosion is difficult, perhaps impossible, to determine, the connective-tissue elements apparently being of the same age and structure.

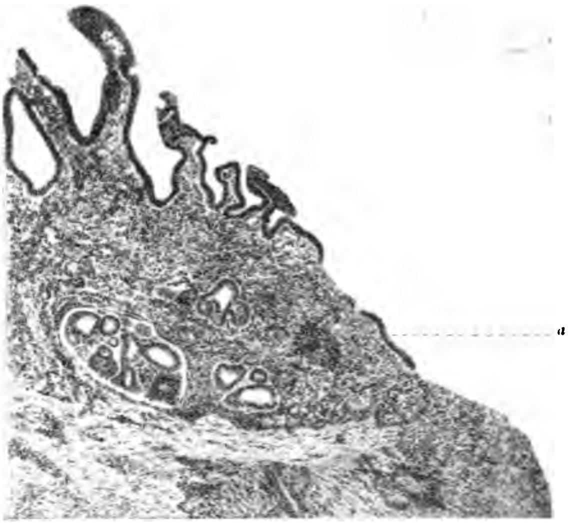

Fig. 48.—(Case No. 18088.) Border of ulcer (*b*) in Figs. 44 and 45. (*a*) Apparent attempt to replace the lost epithelium.

Case No. 28173 (Figs. 52, 54).—A male, aged fifty-five. Four years ago he had "stomach trouble" with distress and belching of sour fluid and gas. For one year the patient's trouble was mild, and then the pain became severe in the epigastrium and extended through to the back and left shoulder, but was more severe in the back. These pains came on two to four hours after meals, and were relieved by forced vomiting. The distress was also relieved by food or soda. There was never obstructive vomiting. The condition would be improved for a few weeks and worse for a couple of months. The pains grew gradually more severe. His appetite was good, his bowels were regular, and there was no

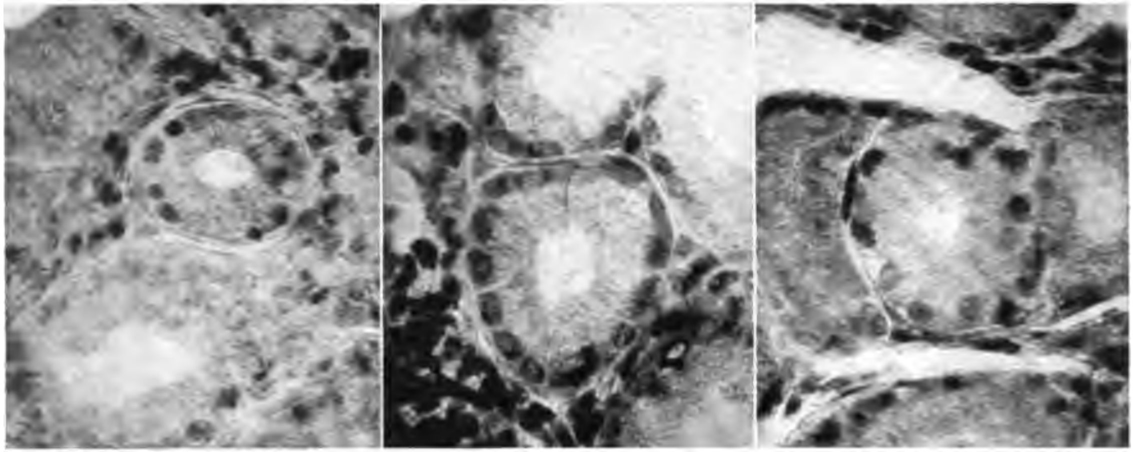

Fig. 49. Fig. 50. Fig. 51.

Figs. 49, 50, and 51.—(Case No. 18088.) Microphotograph showing the regularity of the deeper glands of the mucosa in the borders of the ulcers.

jaundice. Loss of weight 15 pounds. Gastric analysis showed a total acidity of 70, free HCl 50, and combined HCl 10. The feces contained blood. The resected portion of the stomach is about 5 cm. in diameter and contains an ulcer 8 mm. in diameter. There is no gross evidence of hypertrophy of the border. A section through the center shows a conically-shaped erosion, at the base of which there is extensive connective-tissue proliferation which radiates from the base, and which was apparently adherent to some neighboring organ. Grossly there is no sign of carcinoma. The erosion penetrates the muscularis and the scar tissue extends through the whole wall. Upon microscopic examination the base is found to consist of scar tissue, which is necrotic on its internal surface, but without new blood-vessel formation. There are extensive aggregations of lymphocytes along the necrotic border, the lymph-spaces are filled with lymphocytes and radiate from the center of the ulcer. The base of the ulcer shows no signs of glandular elements. The border of the mucosa is markedly infiltrated with lymphocytes. The nuclei of the glands are round and show no irregularity in form. There are no microscopic signs of carcinoma in the specimen.

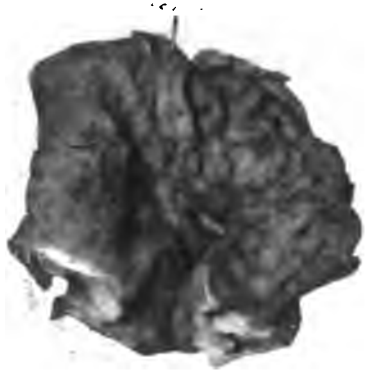

Fig. 52.—(Case No. 28173.) Single gastric ulcer.

CASE NO. 25692 (Figs. 55, 56).—A male, aged sixty, who came for consultation complaining of having suffered from shortness of breath and spells of pain, associated with vomiting of sour material. This was often relieved by food for three to five hours. At times the attacks became worse; milk and hot water at night eased the pain. There was no history of acute perforation. Tenderness was present over an epigastric area the size of the hand. During the past eighteen months he has used the stomach-tube practically every day, and obtained some blood at times. He has had steady pain for two to three years. Appetite good, bowels sluggish. Gastric analysis showed a total acidity 70, free hydrochloric acid 52, combined hydrochloric acid 14, and food remnants. Hemoglobin 82 per cent. At operation the pyloric end of the stomach was resected for perforating ulcer. This specimen contains an ulcer 1 cm. in diameter and about 7 mm. in depth. The mucosa overhangs the ulcer and is composed of glands, between which is an infiltration of lymphocytes. The nuclei of the glands are regular in size and do not show mitotic figures. The mucosa is sharply marked off from the submucosa. The base of the ulcer is composed of connective tissue containing masses of lymphocytes

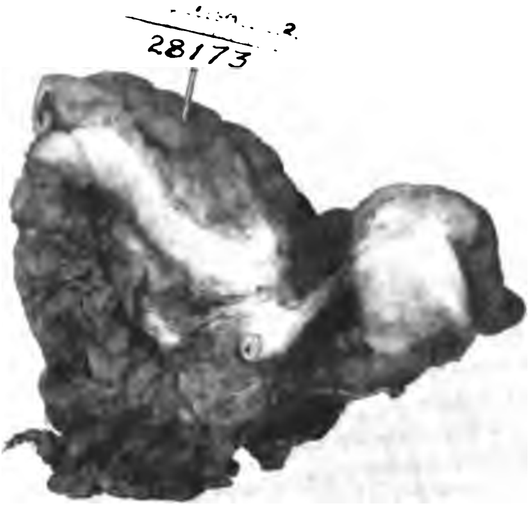

Fig. 53.—(Case No. 28173.) Gross sections through the ulcer showing extension through all the coats of the stomach wall.

and remnants of glands. The nuclei of these gland remnants are small, round, and do not show any mitotic figures. A gross section through this ulcer shows a perforation of all the coats of the stomach by dense connective tissue.

CASE NO. 27381 (Fig. 57).—A male, aged thirty-four, who has had almost constant distress in stomach region for thirteen years. For four months at one time he had relief; the rest of the time distress, pain, gas, and sour vomiting occurred two to four hours after meals. Food or vomiting relieved this pain. The vomitus never contained blood. Loss of weight 45 pounds. There is a note in the history that the patient gives "a steady ulcer history." The pains were very severe but never prolonged. Gastric analysis revealed a total acidity of 42, free hydrochloric acid 25, and combined hydrochloric acid (questionable). At operation a chronic

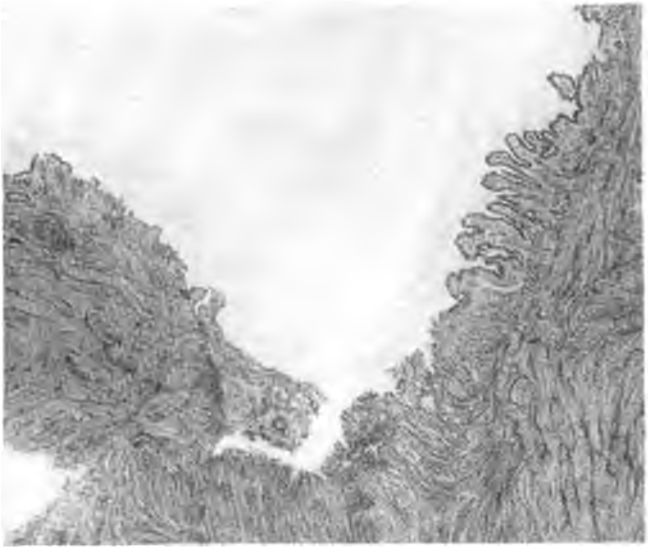

Fig. 54.—(Case No. 28173.) Section through the ulcer showing the character of the border and the necrotic scar-tissue base.

perforating ulcer of the lesser curvature, the size of a dime, was found. It had perforated into the head of the pancreas. The specimen is an ulcer of the lesser curvature 5 mm. in diameter and 5 mm. in depth. The base is composed of scar tissue and has a necrotic inner border filled with lymphocytes and leukocytes, and shows no evidence of new blood-vessel formation. There are no epithelial elements in the base. Aggregations of lymphocytes are present throughout the submucosa. The border of the mucosa is infiltrated with lymphocytes and leukocytes. There are no new-formed capillaries in this border. The glands are composed of cells with round nuclei, which do not show mitotic figures, or any irregularity in size or shape. Between the cells large numbers of leukocytes are seen. No carcinoma is to be seen in the specimen.

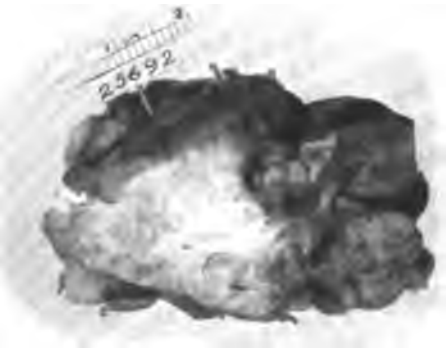

Fig. 55.—(Case No. 25692.) Gross section through a single gastric ulcer.

Case No. 30163.—Female, aged thirty-nine, who was in bed four weeks with "inflammation of the bowels" about nineteen years ago. About two years ago severe pain in the epigastrium and sour belching occurred one and one-half to two hours after meals. Food gave no relief. There was soreness to the left of the vertebral columns during these attacks. Later she began to vomit. This condition became gradually worse, and three or four years ago she began taking hospital starvation cure, which improved her condition. Her appetite was fair, her bowels were regular, but there was some loss in weight. Soda often relieved the pain temporarily. At the time of the patient's visit the pain came on two to three hours after meals, associated with much gas and distress, which was relieved by vomiting and food. Gastric analysis showed a total acidity of 52, free hydrochloric acid 38, combined hydrochloric acid 14. At operation there was found an ulcer 1 cm. in diameter and 0.5 cm. in depth upon the lesser curvature of the stomach. The complete ulcer was resected and examined immediately for carcinoma. It, however, shows only a deep erosion to the muscularis and a base in which there is an extensive infiltration with lymphocytes and scar tissue. In the base there is no evidence of glandular elements. In the immediate border of the mucosa, which projects over the edge of the ulcer, is an infiltration with round-cells but no apparent hypertrophy of the glands. The glands themselves are regular in contour and are composed of cells with perfectly round or oval nuclei, showing no irregular mitotic figures or signs of regular or irregular hyperplasia. There are therefore no signs of carcinoma in the border. The base shows no evidence of granulation tissue. There

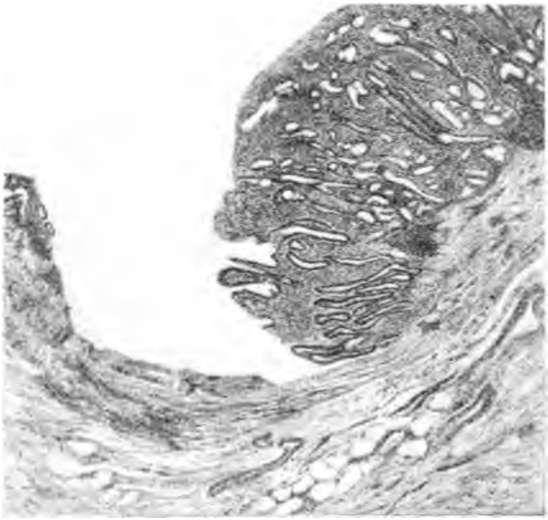

Fig. 56.—(Case No. 25692.) Section through the border of the ulcer showing the overhanging hypertrophic border.

are no new-formed blood-vessels. It is simply a necrotic base. The lymph-spaces extending from the border in the submucosa and muscularis are filled with lymphocytes.

Case No. 30040.—A male, aged forty, who for ten years has had attacks of pain in the upper abdomen. At first these were not severe and were of short duration. The last three or four years these attacks became more frequent and more severe. They lasted from a month to two months, and occurred periodically with intermissions of about a month. During the periods of attack the pain was present every day, lasting one to two hours, and was severe enough to cause vomiting. The patient, at the time of consultation, was able to eat everything, but had considerable gas and had lost 30 pounds in the last three years. Food relieved pain for about an hour. He has never vomited bile or blood, but complained of sour eructations. Gastric analysis showed a total acidity of 58, free hydrochloric acid 40, combined hydrochloric acid 18, and blood present. At operation an ulcer of the posterior wall of stomach 1½ inches below the cardia, and the size of a silver three-cent piece, was resected. The ulcer is 6 cm. in diameter and 3 mm. in depth. The base is composed of scar tissue and necrotic material composed of lymphocytes and leukocytes, and shows no new blood-vessel formation and no glandular elements. The border of the mucosa, which overhangs the connective-tissue border, is infiltrated with lymphocytes, and is

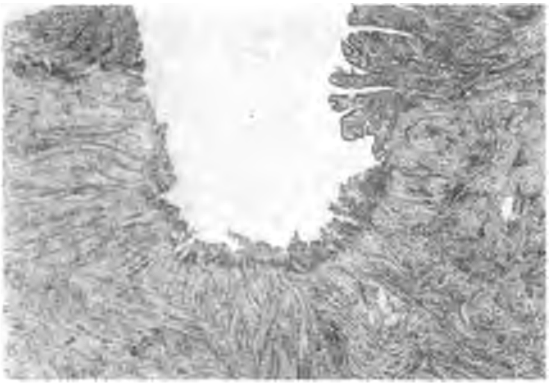

Fig. 57.—(Case No. 27381.) Section through an ulcer showing the infiltration, destruction of the mucosa and the necrotic base.

composed of glandular elements which show evidence of hyperplasia. The nuclei are round and oval and almost uniformly regular in shape, but irregular in size. There are aggregations of lymphocytes throughout the subbasal tissue.

Case No. 27919.—A male, aged fifty-three, who, at his first visit to the clinic, November, 1906, for two or three months had had occasional pain and ache from two to three hours in the gall-bladder region. This was associated with some gas and distress in stomach when he ate liberally. His appetite was good. The laboratory findings were negative. Ten years ago the patient had sour eructations and pain over liver three hours after meals. October 24, 1908, appetite was good; about three hours after food was taken he began to feel distress in epigastrium

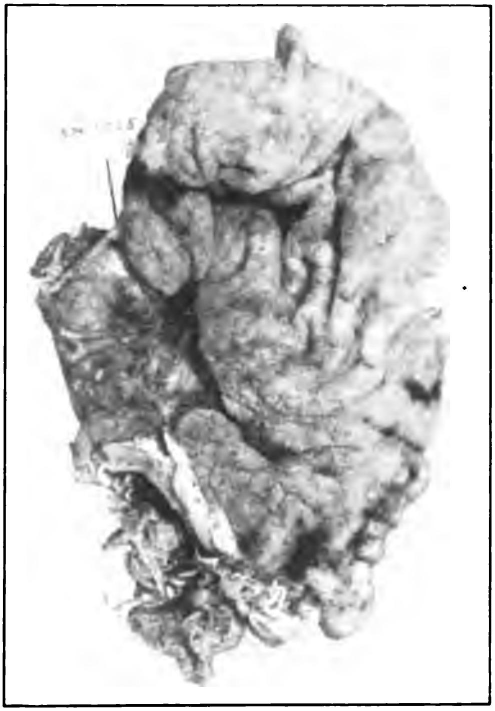

Fig. 58.—(Case No. 21555.) Single gastric ulcer with a carcinomatous border.

with sour eructations; always has gas and occasional vomiting, less than once a week. Soda, alkalies, eating, and irrigation gave relief. He had irrigated his stomach almost daily for years past. Recently he noticed food remnants in the washings. The gastric analysis showed a total acidity of 64, free hydrochloric acid 30, combined hydrochloric acid 14, fatty acids, and food remnants. A second gastric analysis two days later showed a total acidity of 90, free hydrochloric acid 28, combined hydrochloric acid 30, fatty acids, and food remnants. At operation two ulcers at the pyloric end of the stomach on the posterior wall, 1½ inches above pylorus, were found. One was carcinoma. The specimen consists of a resected portion of the stomach, containing two shallow ulcers, each ulcer about 1.5 cm. in diameter and about 3 mm. in depth. They have not penetrated the muscularis. There is an increase in the connective tissue of the submucosa, but this increase does not extend to the muscularis. The glands of the mucosa are regular in shape and have nuclei which are round and show no irregular hyperplasia. The base of both ulcers consists of scar tissue. Beneath the mucosa in the scar tissue are islands of irregular epithelial elements. These small masses of carcinomatous

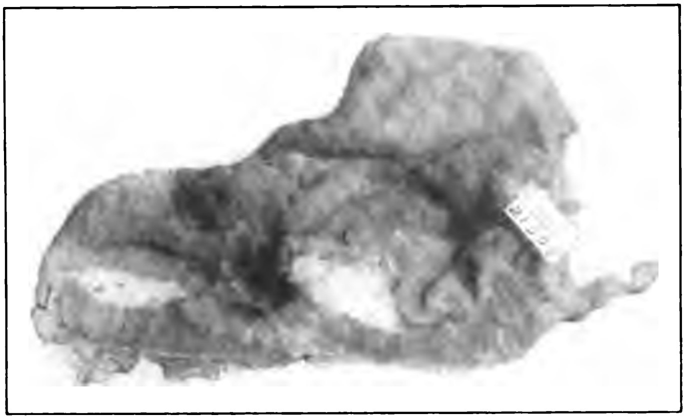

Fig. 59.—(Case No. 21555.) Gross section through the ulcer.

tissue appear to have grown into the scar mass from the immediate edge of the ulcer below the inflammatory mucosa. The mucosa is infiltrated with lymphocytes with only occasional remnants of glands, the nuclei of which show mitosis and irregularity in size. The epithelial islands below the mucosa in this fibrous mass are typical epithelial glands, with the exception that they are irregular in form, and that the cells are irregular in size and show irregular mitosis.

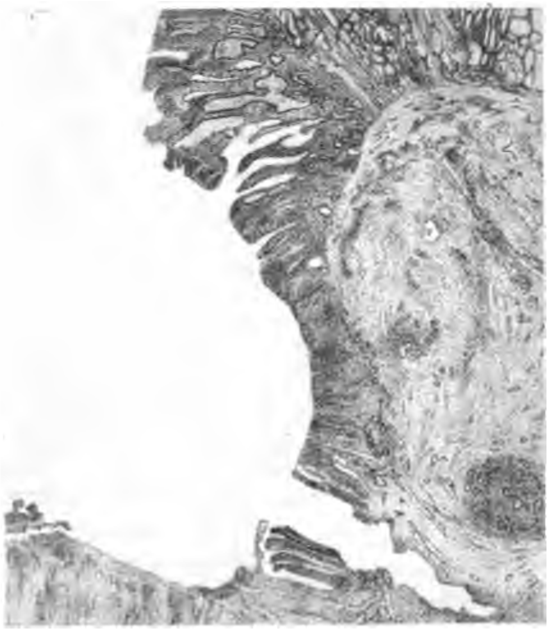

Fig. 60.—(Case No. 21555.) Section through the hypertrophic border showing the ulcer characteristics and the invasion of the submucosa by hyperplastic epithelium of the border.

Case No. 21555 (Figs. 58 to 63 inclusive).—A male, aged sixty-seven, who thirty-five years ago had dyspepsia, but nothing severe, and from then until two years ago had no trouble. At this time he began to have pain, associated with gas and sourness when his stomach was empty. He became gradually worse until four months ago, when he began to vomit "sour stuff" and belch gas.

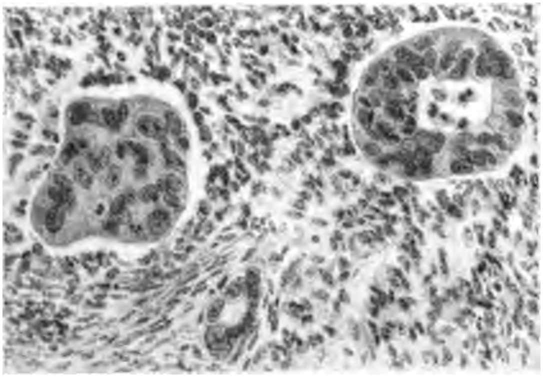

Fig. 61.—(Case No. 21555.) Islands of carcinoma in the submucosa.

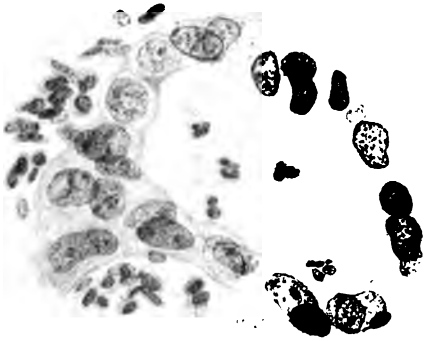

Fig. 62.—(Case No. 21555.) Irregularly shaped epithelial cells in the border of the mucosa near the muscularis mucosæ.

He complained of distress in the epigastrium. There was "coffee grounds" vomitus at this time. In two years he had lost 35 pounds in weight, and most of this has occurred during the last four months. The gastric analysis showed hyperacidity and lactic acid present. One-third of his stomach was resected. The specimen contains an oval-shaped ulcer 3 cm. in its long diameter, about 1.5 cm. in the short diameter, and 1 cm. in depth. A section through the ulcer shows that the base is infiltrated with lymphocytes and composed of connective tissue, which extends through the muscularis and peritoneum. The inner surface is necrotic and contains no epithelial elements, but here and there aggregations of lymphocytes. At a point just below the border is a definite area of perverted epithelium. This area grossly is definitely marked out from the rest of the base, and is the only area which shows carcinoma. It is definitely connected with the border of the mucosa and seems to be an outgrowth from it, which is itself composed of irregular hypertrophic glands, between which is an extensive infiltration with lymphocytes. The epithelial nuclei of this portion of the border are irregular in shape and size.

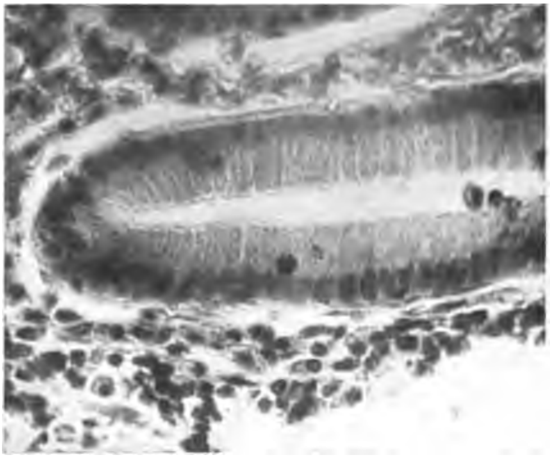

Fig. 63.—(Case No. 21555.) Microphotograph of regularly shaped glands in the mucosa near the ulcer border.

This case is of great importance, because in it we have the exact picture of ulcer as seen in the foregoing cases, with the addition of a definite area of carcinoma situated below the mucosa of the border, and definitely connected with the glands of the same, showing that this area is most probably an outgrowth of the glands in the border of an ulcer, rather than a remnant of an ulcerating carcinoma.

CASE NO. 24527 (Figs. 64, 65).—Male, aged fifty-three, who was examined on January 7, 1908, and who had complained for five months of vomiting, nearly every night for the past month, about bedtime. He had been eating three meals daily and felt no inconvenience through the day, but complained of gas between 8 P. M. and midnight, when he vomited a large quantity of partially digested food. He then felt comfortable until the next night. He has had no severe pain, but has had some loss of appetite. There was no blood in the vomitus. He was always well until August. Hemoglobin 67 per cent. Gastric analysis revealed a total acidity of 60, free hydrochloric acid 20, combined hydrochloric acid 20,

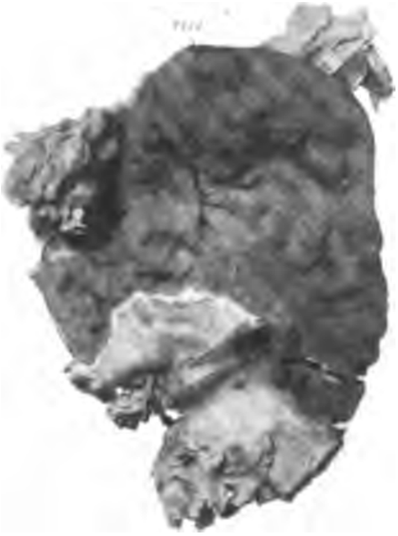

Fig. 64.—(Case No. 24527.) Gastric carcinoma.

fatty acid, but no blood. One-half of the stomach was resected. The resected portion contains a shallow ulcer about 4 or 5 cm. in diameter, and about 2 mm. in depth. The surface of the base is smooth and the mucosa gradually diminishes in thickness toward the base. A gross section shows that it has perforated all walls of the stomach and is infiltrated with carcinoma. Microscopically, one sees an eroded base containing carcinomatous tissue. The mucosa of the border is also extensively involved.

In this specimen we have an erosion of the mucosa and an involvement of all the coats of the stomach under the ulcer by carcinoma. It is impossible to say whether this ulceration was due primarily to carcinoma, or whether the carcinoma was due to an ulceration.

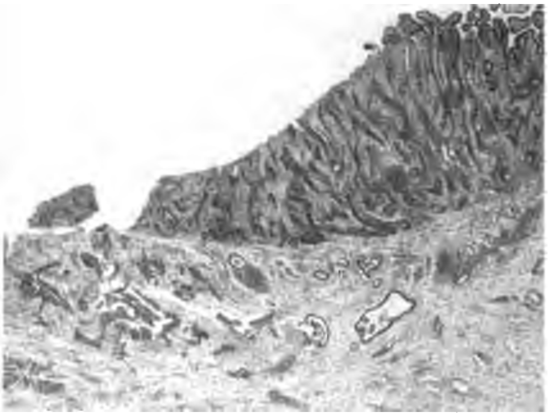

Fig. 65.—(Case No. 24527.) Section through the border of the ulceration showing carcinoma in the border, submucosa, and the base.

CASE NO. 16651 (Figs. 66, 67).—Female, aged forty-two, who sixteen years ago, five days after a confinement, was washing clothes, at which time she had a severe cramp in "stomach." During that summer she had cramps, which lasted from one hour to a day. Toward fall of the same year she began to vomit immediately or about two hours after meals. This vomitus was not sour, there was no blood and no pain. She had no gas from stomach until this last summer. Bowels usually regular. These same

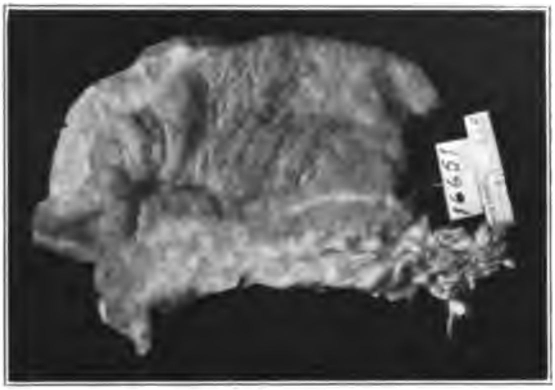

Fig. 66.—(Case No. 16651.) Gastric carcinoma.

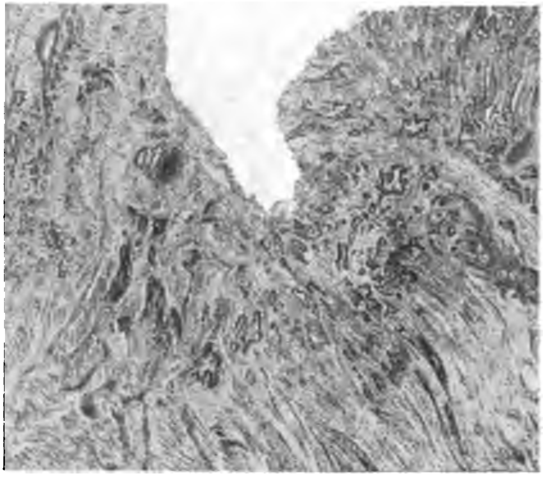

Fig. 67.—(Case No. 16651.) Section through the border of an ulcer in which the mucosa, submucosa and base are extensively infiltrated by carcinoma.

spells lasted until four or five years ago and then began to be less severe. For two years previous to last July she was perfectly well, ate everything, was hearty, strong, and worked steadily, weighed 142 pounds. Then she began to lose her appetite and felt weak and tired.

There was no pain. In August she began to belch as soon as food was taken; often the vomitus contained a previous meal. A tumor was palpable in the epigastrium. Hemoglobin 27 per cent. Gastric analysis showed a total acidity of 50, no free hydrochloric acid, combined hydrochloric acid 5, lactic acid, blood, and fatty acids. At operation about three-fourths of the stomach were resected. The specimen contains an ulcer about 2 cm. in diameter and 0.5 cm. in depth, with a border which overhangs about 3 mm. Upon gross section, there is a connective-tissue proliferation extending from the base to the peritoneum. The former rests upon the lower half of the musculature, through which it has almost completely eroded. In the base one sees grossly and microscopically carcinomatous areas, some of which have become partially eroded. In the overhanging border there is an extensive carcinomatous change with a hyperplasia of the glands and an infiltration with lymphocytes. The carcinomatous areas extend completely through the wall and the scar tissue of the perforation.

CASE NO. 21882 (Figs. 68, 69).—Female, aged thirty-eight. Eight years ago she was weak, tired, and worn out; four to five years ago she became weaker. About one and one-half to two years ago she had her first sickening pain. There was no nausea, no vomiting, but occasional sour eructations. About two weeks ago there was a severe pain in the back and left costal arch. A tumor in epigastrium has been noticed for about seven or eight months; epigastric pain, gas, nervousness, weakness, and loss of flesh. Gastric analysis (second test) showed a total acidity of 50, free hydrochloric acid 30, combined hydrochloric acid 14. At operation two-thirds of the stomach were removed for carcinoma associated with ulcer. The specimen contains an ulcer from 3.5 to 4 cm. in diameter and from 1.5 cm. to 2 cm. in depth. There is a perforation of all the coats of the stomach, which has become adherent to neighboring organs. There is an extensive carcinomatous involvement of the ulcer base.

The specimen shows that the ulceration, although it might have started as a simple ulcer, has become deeper through the process of erosion of tissue composed of carcinoma. Such specimens have undoubtedly led to the belief that all ulcers which show carcinoma were developed in this manner. It is impossible to say whether or not this originally was an ulcer, or carcinoma with secondary ulceration.

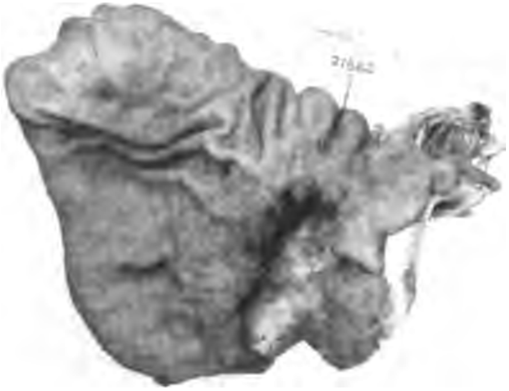

Fig. 68.—(Case No. 21882.) Gastric carcinoma.

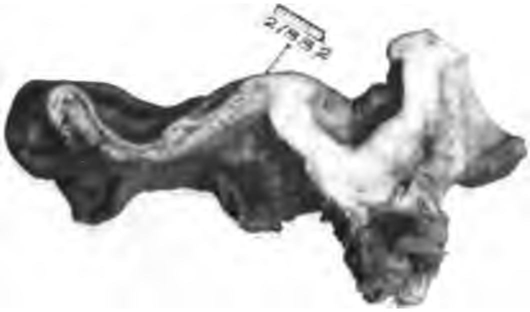

Fig. 69.—(Case No. 21882.) Gross section showing the great depth produced by the process of erosion

Macroscopic Description.—Ulcers of the stomach vary in size from 1 mm. (Figs. 44, 45, 46) to several centimeters in diameter, and from 1 mm. to 2 or 3 cm. (Fig. 30) in depth. They may be single or multiple (Fig. 44). The base may be ragged or smooth. All of the ulcers in my series have rough bases because they were removed soon after an acute attack or in the stage in which mild inflammatory symptoms were present. The base contains elements of the mucosa, muscularis mucosæ, submucosa, or muscularis, depending upon the extent of the necrosis, as may be seen in Fig. 46, in which the smallest ulcer (Figs. 44, 45, 46) has eroded about half of the mucosa, forming a base containing glands and infiltrated interglandular stroma. The largest ulcer in case No. 18088 (Fig. 45) involves the muscularis. On section through the specimen, the immediate base is seen always to be composed of connective tissue, which speaks perhaps for the gradual development of the ulcer instead of a rapid destruction below the muscularis mucosa. The initial erosion or necrosis of the mucosa may be of rapid formation, but the connective-tissue base seems to show that the process is sufficiently slow below the muscularis mucosæ for the formation of a temporary, if not permanent, barrier of scar tissue. Hemorrhagic areas in the base are present in many ulcers in this series. The border of the mucosa, which has the color of congested normal mucosa, does not always show evidence of hypertrophy, especially in small ulcers. In the larger ones, which appear to be of long standing, the border of the mucosa projects or hangs over the edge and is almost always hypertrophic When one examines a fresh ulcer in gross section there are four distinct coats visible: the mucosa, submucosa, muscularis, and subserosa. These are either eroded in the base of the ulcer or infiltrated with scar tissue (Figs. 44, 45). It is difficult and often impossible to detect epithelial growths in the wall of early ulcers (Fig. 59). In many of such cases which, grossly, one is justified in calling an ulcer, early microscopic carcinomatous invasions from the mucosa exist (Fig. 59).

Microscopic Description (*Low Power*).—The mucosa of an ulcer border rests on or is marked off from the submucosa by the muscularis mucosa, which is composed of two or three rows of muscle-cells. The glands which are regular in shape in the border of some ulcers may be seen cut longitudinally or transversely (Figs. 46, 47). The demarcation between the glands and the interglandular tissue is sharp. There is a regularity in the arrangement of the component parts of the mucosa, which is best seen with low power. An infiltration with leukocytes or lymphocytes, or both, destruction of the glands, and invasion of the submucosa, may be readily seen with this power. The base is composed of dense connective tissue, the general growth of which is perpendicular, or nearly so, to the base (Figs. 45, 54). The base, which extends to the border of the mucosa, is infiltrated and necrotic (Fig. 57). If there are remnants of irregular glands and the muscularis mucosæ has been destroyed or penetrated by perverted epithelium, one may be sure that carcinoma is present (Figs. 65, 67). If the base does not show these elements, a careful search should be made for epithelial structures in the rest of the submucosa (Fig. 60). If such be present, they should be studied for any irregularity in architecture, as seen in Figs. 61, 62. If perfectly regular (Fig. 63), one may be dealing with an adenoma. If irregular (Figs. 61, 62) one is surely dealing with carcinoma. In the mucosa the differentiation between infiltrated tissue, inflammatory hyperplastic tissue, adenoma, and carcinoma is not always possible with a low power. The submucosa and muscularis in ulcers and ulcers associated with carcinoma in the immediate vicinity of the lesion are infiltrated with scar tissue, and usually the lymph-spaces are filled with lymphocytes. Not infrequently aggregations of lymphocytes may be seen throughout the wall, especially in the mucosa and submucosa.

Microscopic Description (*High Power*).—Groups of cells (Figs. 61, 62) such as may be seen in a section through one gland should be studied with the high power to determine whether or not the border of an ulcer has passed beyond the stage of inflammatory hyperplasia. A study of the glands in this manner reveals the following conditions: In the smallest ulcer seen in Fig. 3, the bases of the cells rest regularly on a basement membrane and do not penetrate it. The relative proportion between the nucleus and the protoplasm is that of a differentiated cell, and is about 1 : 3 or 1 : 4. The surrounding stroma is infiltrated with lymphocytes. The nuclei take the stain (Unna's polychrome methylene-blue or hematoxylin) densely, and are either oval or round and vary in size and shape within the normal limits of normal gastric gland nuclei, depending on the plane in which they are cut. They are regular in shape and size. In the border of an ulcer which shows a more marked reaction to the irritant the same picture may be seen, accompanied by more extensive hyperplasia and increase in the relative proportion of the size of the nucleus to protoplasm. The nuclei stain less densely. In this condition the line of demarcation between the stroma and the gland is usually not so regular. The glands may be, and often are, distended and distorted. In the same specimen in which such a hyperplasia occurs one may frequently see glands which are more irregular and possess all the characteristics of hyperplasia, with the addition that the nuclei are irregular in size and shape beyond the normal limits (Figs. 61, 62). Indeed, some may be two or three times the size of the nuclei lying next to them. Such irregularity is seen in more extensive carcinomata and no hesitation occurs in making a diagnosis. Such a picture occurs in very early cases in the mucosa, before the submucosa has been invaded, and should be also considered carcinoma. One need not always wait for the basement membrane to be ruptured or invasion of tissue in which normally there is no epithelial tissue. There are many cases, however, in which the differentiation between hyperplasia and malignant hyperplasia is impossible at present on account of the apparent lack of demarcation between simple inflammatory hyperplasia and malignant hyperplasia. We are beginning to have it strongly impressed upon us that hyperplasia is a forerunner of malignancy, that hyperplasia varies in degree, and that carcinoma is a malignant hyperplasia which also varies in degree, and that some of the degrees, so far as the morphology is concerned, are indistinguishable, if not identical.

Ulcer and Malignancy.—The question, Do ulcers become malignant as one of their sequelæ? seems, from my material at least, to be answered in the affirmative. What percentage heal, perforate, or become malignant is impossible to determine. The close association of carcinoma with ulcer may be strikingly seen in the fact that 71 per cent. of all our resected specimens of the stomach for carcinoma were associated with definite ulcers (Wilson and MacCarty),* and that 68 per cent. of the resected ulcers of the stomach, including the duodenal ulcer, which rarely becomes malignant. were associated with carcinoma.

Ulcer Process and Life History of Gastric Ulcer.—From a study of the morphology of ulcers it would seem that the process of ulceration, erosion, or necrosis manifests itself in single or multiple lesions, and that the initial lesion, at least in many cases, is a destruction of the mucosa itself, and that the reaction to this destruction is a connective-tissue proliferation, and an attempt on the part of the epithelium of the mucosa to replace that which was lost (Fig. 48). The architecture of the connective-tissue proliferation in the underlying tissue forming the base of all the ulcers studied in this series is such as to form an attempted barrier against further destruction. This barrier undergoes necrosis in the ulcer crater, thus increasing gradually the depth. If the base contains carcinomatous tissue, it too shares in the destruction (Figs. 65, 67). Perforation occurs by extension of the inflammatory process through the lymphatics, or by direct erosion, as may be seen in some acute cases. One may state the life-history of gastric ulcer after the initial necrosis, the nature of which we do not know, as a gradual necrosis of the mucosa, muscularis mucosæ, submucosa, and subserosa. Ulcers heal, as may be seen at autopsy; they deepen and perforate as seen at autopsy and operation, or become malignant, as seen especially at operation. The last condition is often the sequel of ulcer, because we find ulcers which show no carcinoma, and ulcers which, grossly and microscopically, are exactly similar to the ulcers without carcinoma, but which contain small areas of irregular gland structures, with irregular nuclei, which show irregular mitosis. These islands of perverted epithelium may be seen in the dense scar tissue of the submucosa, just under and connected with the mucosa of the border (Fig. 21). Such ulcers do not present any epithelial elements in the base, and are therefore not ulcerated carcinomata.

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* "Amer. Jour. Med. Sci.," Dec., 1909.

CLINICAL DIAGNOSIS

The details of the clinical diagnosis will not be considered in this paper. While there has been a vague feeling from the pathologic standpoint that carcinoma frequently occurs upon gastric ulcer, strong pathologic evidence has been wanting. The clinician has for years noticed that carcinoma of the stomach often follows a prolonged history of gastric ulcer, and has believed that such was a forerunner of malignancy. The evidence, however, was only circumstantial. The fact established allows and demands a stronger admonition to the diagnostician, who, as soon as he has diagnosed ulcer of the stomach, must consider the strong possibility of its becoming malignant. The chances of this occurrence may be readily seen, as stated above, in the fact that 71 per cent. of our resected specimens of gastric carcinoma were associated with ulcer, and that 68 per cent. of our resected gastric ulcers were associated with carcinoma. It must be granted that gastric ulcers do sometimes heal with or without treatment, when seen early, or when not seen at all until autopsy, but unfortunately the early stage of ulcer cannot be so easily recognized, and, when recognized, at the first definite sign or symptom it is impossible to determine whether the ulcer is a small one or a large one, or whether it has been present for weeks or months without having given rise to definite symptoms or even symptoms other than slight discomfort. Many cases with ulcers do not give a history of vomiting blood. As may be seen in cases 30163, 28173, 27381, 27919, 21882, 16651, 24527, many cases give a history of hyperacidity and do not show hyperacidity at the time of gastric analysis, and therefore absence of hyperacidity is of no value in a case which otherwise gives gastric symptoms. Lactic acid and fatty acids are not to be expected until there is mechanical or motor obstruction, which may occur associated with a small or a large ulcer, depending upon its location. The length of the history of epigastric discomfort or distress varies within wide limits, and the case with a short history often has a more extensive lesion than one with a long history. The lesion occurs most often, and practically always, in early

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adult life or middle life. Our cases have occurred oftener in males than in females. A few, as may be seen in cases 18088 and 30163, give previous histories which appear to be appendicitis. This coincident, if it be a coincident, is well worth considering, however, as a possible etiologic factor, in view of some experimental and clinical experiences. Cannon has, by the injection of irritants into the large intestine, produced a retardation of the gastric discharge. Roger has shown that the injection of betanaphthol into the cecum produces erosions of the mucosa. Litthauer has produced ulcers, which do not heal, by the production of localized anemia and destruction of the mucosa. Clinically, many cases of appendicitis, especially chronic appendicitis, present symptoms of gastric disturbance which predominate over the symptoms in the appendix region. Such cases after the removal of the appendix are relieved, and recover from the gastric disturbances. In these cases the stomach and duodenum present no lesion recognizable at exploration. Such clinical and laboratory experiences are sufficiently striking to warrant further study and experimentation in regard to the possible production of pyloric spasm, gastric anemia, hyperacidity, and necrosis or ulceration of the mucosa.

RÉSUMÉ

1. Ulcers may be single or multiple and in different degrees of extension in the same specimen.
2. After the initial destruction of the mucosa, there is definite deepening of the ulcer by necrosis.
3. This deepening is sufficiently slow to allow a dense connective-tissue barrier against perforation to be formed.
4. Ulcers heal, perforate, and become malignant.
5. Perversion of the glandular elements occurs in the mucosa, and the cells then invade submucosa.
6. One cannot say positively that all carcinomata of the stomach have developed on ulcer, because carcinomatous tissue in the base of an ulcer may be an ulcerated primary carcinoma.
7. The duration of the clinical history is no positive index of the extent of the lesion.

8. The absence of blood in the vomitus or gastric contents at the time of laboratory analysis, when associated with gastric symptoms, is not evidence against the presence of ulcer.

9. Absence of hyperacidity at the time of gastric analysis also is not evidence against the presence of ulcer.

10. Clinically, with our present means of diagnosis, it is impossible to say that a gastric ulcer is not malignant.

11. The intimate relationship between irritation in the appendix or cecum and gastric disturbance may have some bearing in the etiology of ulcer.

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RADICAL OPERATION FOR CANCER OF THE PYLORIC END OF THE STOMACH*

REVIEW OF 266 PARTIAL GASTRECTOMIES

By WILLIAM J. MAYO

The operation of partial gastrectomy and pylorectomy has been performed in St. Mary's Hospital 266 times (C. H. and W. J. Mayo, April 21, 1897, to Jan. 27, 1910) with 34 deaths, an average mortality of 12.4 per cent. During the year 1909 there were 46 operations with 4 deaths, an average mortality of 8.6 per cent. Forty-two of the 266 operations were performed for benign tumors, or ulcers, or the diagnosis was not microscopically established; they have, therefore, been excluded from the statistics.

TABLE 1.—OPERATIONS FOR CARCINOMA INVOLVING THE PYLORIC END OF THE STOMACH

Total number	224
Males	163
Females	61
Age of oldest	81
Age of youngest	30
Average age	53
Patients Operated upon over Five Years Ago	
Total number	50
Present condition known	39
Alive and well (one 8 years 2½ months; one 8 years; † one 7 years 2 months; one 6 years; one 6 years 11 months; one 5 years 3½ months; one 5 years)	8
Patients Operated upon over Four Years Ago	
Total number	85
Present condition known	64
Alive and well	13

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* Reprinted from "Jour. Am. Med. Assoc.," May 14, 1910, vol. liv, pp. 1608-1616.

† Has since died of recurrence.

Patients Operated upon over Three Years Ago

Total number	117
Present condition known	88
Alive and well	18

Patients Operated upon Less than Three Years Ago

Total number	107

Cases in the last group (operations less than three years ago) are too recent to be of any statistical value as to the question of cure.

Partial gastrectomy for the cure of malignant disease of the stomach has never been favorably accepted, and, considering that this organ is more frequently the seat of cancer than any other in the human body, the percentage of operations has been exceedingly small. The reluctance of practitioners to advise and of surgeons to practise partial gastrectomy is based on several considerations: First, in the greater number of cases the disease cannot be diagnosticated in time to effect a radical cure; second, the operation itself has an immediate mortality which is high in proportion to the ultimate prospect of cure. I do not believe this pessimism to be justified by the facts.

It is my intention, not to go into the details of the diagnosis of gastric cancer, but to call attention to two important indications for operation, which, if observed early, will be the means of securing a number of patients in time to benefit them. (1) Food remnants found repeatedly in the stomach after twelve hours, when taken in connection with the clinical history, should indicate a surgical consultation, and, in the large majority of cases, this special investigation will lead to an exploratory operation. (2) The finding of a movable tumor in the pyloric end of the stomach has a surgical significance which cannot be overestimated. It is a great mistake to suppose that the presence of a movable tumor, palpable through the abdominal wall, is indicative of a hopeless condition. While it is true that ulcer and its results often give rise to gastric retention and occasionally to tumor, other things being equal, surgical relief is quite necessary in these cases.

Without in any way minimizing the value of laboratory examinations of the stomach-contents, etc., I am more and more convinced that gastric cancer itself does not give rise to diagnostic symptoms during the curable stage. In the later stages the clinical picture and laboratory findings are characteristic; by this time, unfortunately, the prognosis is equally as plain as the diagnosis, but, if the disease is situated in the pyloric end of the stomach, it early introduces mechanical conditions which furnish the most valuable information.

Heretofore we have asked for a diagnosis in carcinoma of the stomach and have shifted the burden of responsibility to the internist. In the future let us ask, rather, for surgical consultation in all cases showing evidences of mechanical obstruction or tumor.

So much can be said concerning the doubtful group of cancers from which we obtain our cases in which cure is possible; but what shall be said as to the desirability of operation in advanced cases? Partial gastrectomy offers a number of months of apparent cure, even when it is impossible to remove all of the involved lymphatics, and with a mortality but slightly above that of gastrojejunostomy, which, at best, gives only a few months of more or less uncomfortable existence.

Mikulicz has called special attention to the marked palliation which is produced by removal of the sloughing mass, as contrasted with methods which look only to overcoming the obstruction.

In a high percentage of cases, cancer of the stomach is, at the first examination, plainly inoperable, and without exploration, other cases are doubtful.

Palmer studied the histories of 335 patients suffering from cancer of the digestive tract, who presented themselves at our clinic between January 1, 1908, and September 1, 1909, and found the following definite signs of metastasis: (1) implantation carcinoma of the sigmoid, "the rectal shelf of Blumer"; (2) supraclavicular metastasis; (3) carcinomatous involvement of the umbilicus (button-like umbilicus); (4) free fluid in the peritoneum. These various conditions, by reason of the metastasis alone, eliminated about 12 per cent. of the total number as hopeless at the time of the primary examination.

TABLE 2.—CASES OF CANCER OF THE STOMACH EXAMINED IN OUR CLINIC BETWEEN JAN. 1, 1908, AND SEPT. 1, 1909

Total number	335
Hopeless and not admitted to the hospital	146
Resections	78
Gastrojejunostomies	39
Excision malignant ulcer	2
Exploration inoperable disease	70
	335

Technic of Operation.—As regards the technic of pylorectomy and partial gastrectomy, I have little to present that is new. An effort should always be made to remove the lymphatic area whether it is diseased or not. The general rule holds good, in the earlier stages at least, that the glandular involvement follows the regular lymphatic routes to the four primary groups of lymphatic glands into which the pyloric end of the stomach drains. We have observed, both in cancer and in ulcer, that when there was glandular involvement of only moderate degree, the evident adenopathy was usually confined to the glandular groups which accompany the four arteries—the superior pyloric, the gastric, the gastroduodenal, and gastro-epiploic. The lymphatics in this region eventually drain into the celiac and pre-aortic glands, but by routes that are far from regular. In a study of the lymphatics in a large number of cases in which we had made partial gastrectomy, Wilson and MacCarty have found a curious tendency of the disease to pass by certain glands, and have demonstrated that carcinomatous emboli in the early stages do not necessarily involve glands one after another, but may primarily pass into glands at a considerable distance.

Explorations and palliative gastrectomies have given me opportunities to note the glandular involvement in the late stages of the disease. In such cases, due either to unsuspected primary lymphatic connections or to obstruction to the regular lymphatic channels causing extension along by-paths, I have seen involvement of the glands in the transverse mesocolon, the glands about the common duct, those along the upper border of the pancreas, and in other situations. It is evident, therefore, that removal of the lymphatic area in gastric cancer is not a simple proposition, and it indicates only too clearly that to secure the best results the disease must be removed before the lymphatics are infected.

Prophylaxis of gastric cancer can be aided by the excision of calloused ulcers of the stomach. In the 266 cases in which we have performed resection, Wilson and MacCarty examined histologically 218, and were able to show that 71 per cent. of the cancers had their origin in chronic gastric ulcer.

We have seen primary cancer of the duodenum in but 5 cases, and in only one of these did it appear that the cancer might have its origin in previous ulcer of the duodenum. This justifies the belief that gastrojejunostomy is the operation of choice for duodenal ulcer. In two instances, however, we found a gastric cancer which apparently had its origin on the gastric side of a duodenal ulcer which involved the pylorus. For gastric ulcer, the removal of the ulcer itself would seem to be the only safe procedure. We have practised this for several years wherever it seemed possible, and in a number of instances have unexpectedly found cancer on ulcer in the early stage.

The fundus of the stomach, like the fundus of other organs, as contrasted with the neck, is not largely supplied with lymphatics, and those present lie, to a large extent, in the vicinity of the cardiac orifice. The fundus, from a line about opposite the cardia, passes its lymph-streams upward into the lymphatic glands about the cardia and to the left to the glands lying in the vicinity of the spleen, making a rather sharp lymphatic demarcation between the fundus and the pyloric end of the stomach. This indicates the amount of stomach necessary to be removed in pyloric cancer and makes pylorectomy and partial gastrectomy a fairly definite procedure (Fig. 70).

A typical resection necessitates the removal of all of that part of the stomach lying to the right of a line dropped vertically from the cardiac orifice, although in some cases more of the fundus must be removed on account of direct extension of the disease. It sometimes happens that either the anterior or the posterior wall is more extensively diseased than the other. In this event we have not found it difficult to remove more of the diseased wall of one than the other, and to throw the suture line anterior or posterior as the necessity may indicate.

Billroth, to whose far-sighted pioneer work in gastric surgery we owe so much, had to contend with shock from loss of blood, which is now obviated by primary ligation of the blood-vessels. From a technical standpoint, the glands and gland-bearing fascia can best be removed at the time the blood-vessels are ligated, and the early ligation of these vessels not only makes the part of the stomach to be removed avascular, but also separates it from its connections so that the succeeding steps in the operation are greatly facilitated.

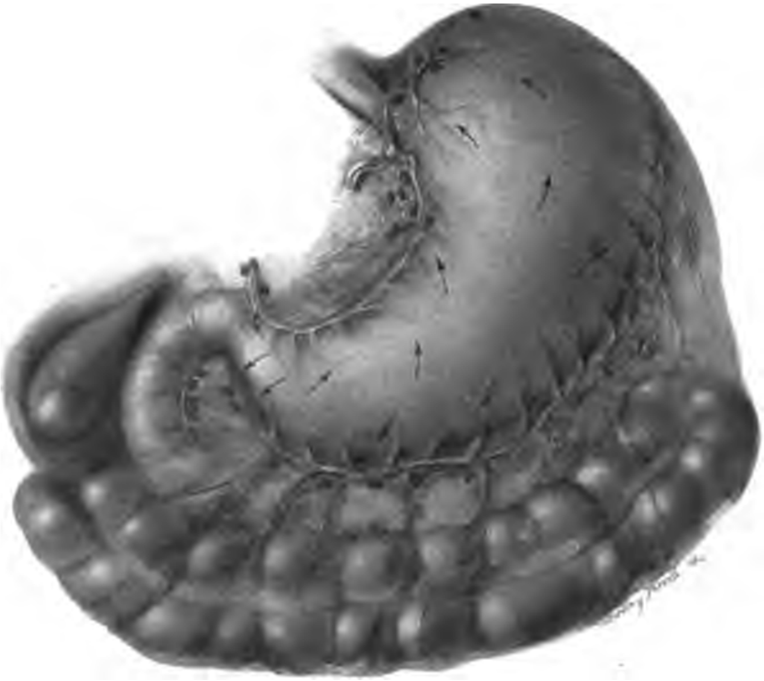

Fig. 70.—Anatomy of the stomach with especial reference to the blood-vessels and lymphatics. The arrows indicate the direction of the lymphatic flow.

The blood-vessels are four in number, each accompanied by definite lymphatic channels and glands. These blood-vessels have their origin from the celiac axis, the gastric artery directly from the celiac axis, the superior pyloric and gastroduodenal by way of the hepatic artery, and the left gastro-epiploic from the splenic artery. As a general rule, it will be most convenient to make the separation of the superior border of the stomach first, beginning the operation by (*a*) ligation of the superior pyloric vessel, (*b*) the gastric, (*c*) the left gastro-epiploic, (*d*) the gastroduodenal vessels. As each vessel is secured, the glandular separation is effected. The procedure is as follows (Fig. 71):

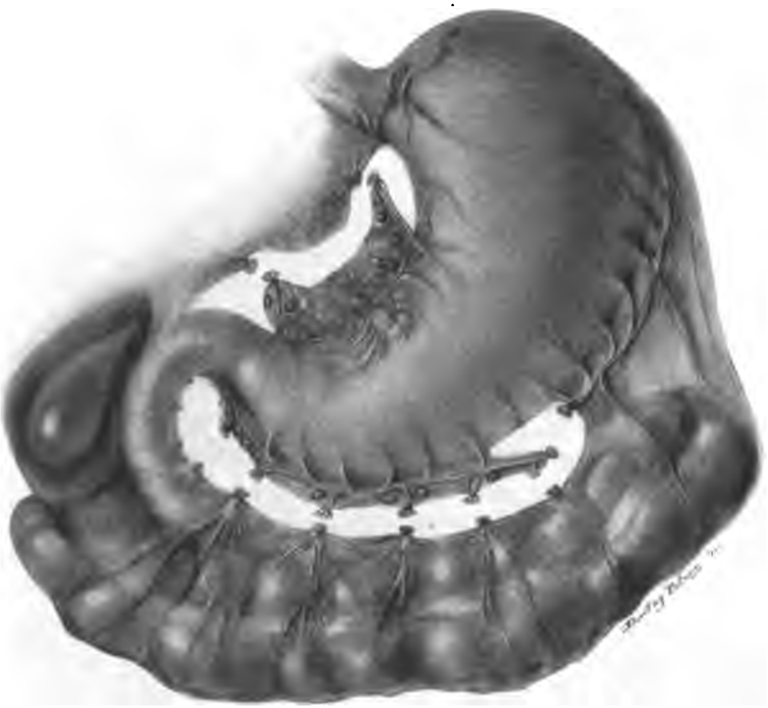

Fig. 71.—Vessels ligated and lymphatic dissection completed.

Step 1: An opening is made through the gastrohepatic omentum into the lesser cavity of the peritoneum. The superior pyloric artery is isolated at as great a distance as possible from the duodenum and is double-tied and divided between. The terminal branches are dissected upward from the duodenum so that they hang with the glands and fat attached about the pyloric ring. This frees the superior border of the duodenum for 1½ or 2 inches. The glands accompanying the superior pyloric artery are very often involved, and it should be remembered in separating them that the common duct lies in close proximity and may be exposed to injury. In one case I accidentally cut the common duct through three-fourths of its circumference transversely. It was sutured with catgut and a separate drain through a stab wound employed through which there was a biliary discharge for nearly three weeks. On two occasions I found the gall-bladder attached by the fundus to a pyloric growth and it was removed without difficulty as it lay attached. Adhesions to the liver, if present, are separated at this stage of the operation.

Step 2: The stomach is drawn downward and to the right and the gastric artery is caught at the highest possible point. In thin subjects it may be ligated close to the celiac axis, but in the average case it will be most easily isolated just distal to the large branch which leads up to the esophagus and cardia.

This ligation is usually made from a needle with two independent ties of catgut, as the tissues are liable to retract—and if the ligature slips it is difficult to catch the artery, as I have reason to know. The anterior and posterior gastric branches are caught and tied in such a manner that the fat and glands and distal part of the vessel can be dissected free from the upper part of the lesser curvature and a space 1½ inches in extent next to the cardiac orifice is exposed. This dissection should be very carefully made, because, as pointed out by Hartmann and Mikulicz, it is essential that the whole of the lesser curvature to a point close to the cardiac orifice shall be removed. To a considerable extent the lymphatics lie in the wall of the stomach, and, as demonstrated by Cunéo, a large majority of pyloric cancers spread upward along the lesser curvature, and the failure to remove involved stomach is most apt to occur in this situation.

Step 3: Careful examination is now made on the greater curvature for the glands which begin at a point about opposite the cardia.

These glands are usually visible even when not diseased. The left gastro-epiploic vessels are caught and double-tied to the left of these glands, and the anterior and posterior gastric vessels caught and tied as they come from the stomach, and the greater curvature cleared for a space of at least 1½ inches. The transverse colon is drawn well into view so that the middle colic artery can be examined at frequent intervals to avoid injury, and the gastro-epiploic vessels are tied with the gastrocolic omentum in sections from left to right sufficiently close to the transverse colon to leave the glands lying on the vessels of the greater curvature by a good margin. As this dissection proceeds it will sometimes be found that the avascular area which lies in the circle of the middle colic vessel and the posterior layer of the mesocolic peritoneum is attached to the growth. If this is the case, the attached peritoneum can be cut out and removed with the growth. The opening thus made in the transverse mesocolon can be used later through which to make the gastrojejunostomy. As the dissection proceeds to the right the middle colic artery is carefully exposed and traced to its origin in the superior mesenteric artery just at the lower edge of the pancreas, otherwise it may be accidentally injured. Krönlein has shown that in three out of four cases obliteration of the middle colic vessel will lead to gangrene of a portion of the transverse colon and necessitate a coincident resection.

Step 4: Removal of the inferior gastroduodenal glands which lie below and to the right of the pylorus, about the head of the pancreas and in the curve of the duodenum, is the next step in the operation. The gastrocolic omentum is tied in sections rather close to the transverse colon, the fat and glands are lifted up from over the head of the pancreas, and the blood-vessels anastomosing with the branches of the superior pancreatoduodenal artery are caught and tied. Separation is continued upward, clearing the inferior border of the duodenum for at least 2 inches until the gastroduodenal artery is reached in the groove between the pancreas head and the duodenum behind the pylorus. Division of these vessels allows raising in one piece all this important group of glands.

Step 5: The posterior surface of the upper duodenum is separated from the pancreas, and if the pancreas is adherent to the gastric growth, a piece is shaved off, allowing it to remain attached to the growth by adhesions. In other cases it becomes necessary to remove more or less of the pancreatic structure. If the involvement is extensive, it is better to leave this part of the operation until the stomach is either cut across and separated from the duodenum, or the line of stomach section on the cardiac side is finished and the stomach turned over, in order that this portion of the dissection may be completed under inspection. If such injuries to the pancreas are properly cared for, we have not found that they give rise to serious consequences. Haberkant found that a mortality of 76 per cent., and Mikulicz that a mortality of 74 per cent., followed the removal of such pancreatic involvement. It is the rule that these operations are more serious because more extensive, but we have not found any special mortality due to operable pancreatic complication. The best manner of treating such an injury to the pancreas is to cover it as far as practicable with the sheath and posterior peritoneum, and after completely closing the end of the duodenum, if possible, the stump of the duodenum should be buried in the injured surface of the pancreas.

Step 6: As a rule, the duodenum beyond the pylorus is not involved to any considerable extent, but to make sure it is best to remove about an inch of it. A firm compression forceps is placed next to the pylorus and a half inch below this a pair of light holding clamps on the duodenum above and below to prevent this holding clamp from slipping off. The duodenum is divided between and both raw surfaces are cauterized with the actual cautery. The pyloric end of the stomach is turned completely over on the left side of the patient. The stump of the duodenum is sutured with a continuous catgut suture passed through the duodenum and around the forceps, as in the Pilcher operation for the removal of internal hemorrhoids. The holding clamp is slipped off, the catgut sutures are drawn tight and tied. Three-fourths of an inch below this a purse-string suture of medium-sized linen is placed about the duodenum, the ends of the catgut strands are cut short, and the duodenal stump is invaginated in a manner similar to the stump of an appendix in appendectomy. A second linen purse-string suture is now placed about the duodenum; behind it catches the pancreatic sheath so that the stump may be buried against the head of the pancreas, as recommended by Willy Meyer. Finally the stumps of the adjacent tied gastrocolic and gastrohepatic omenta are so adjusted by fine linen sutures as to make further protection. In our experience this technic has been adequate and we have had no cases of duodenal leakage. The field of operation is now searched for any bleeding points and protected with gauze.

Step 7: The stomach is drawn to the right and holding clamps are placed from the space cleared on the greater curvature in Step 3 to the space cleared on the lesser curvature in Step 2. When the stomach is cut across, these clamps sometimes slip near the cardia and the stomach retracts. To prevent this, a pair of bayonet holding clamps are placed on the proximal side from above down, grasping the upper part of the stomach half-way across. A clamp is now placed distally, to prevent leakage from the end to be amputated, and the stomach is divided between. The divided proximal gastric surface is cauterized with the actual cautery and the stomach turned in by a continuous chromic catgut suture beginning on the greater curvature. This suture is applied quite tight and is the one we have described on several occasions. It starts on the mucous surface, passes through all the coats to the peritoneum and back on the opposite side through all the coats to the mucous membrane, is then tied and the end cut short. The suture now passes through all the coats from the mucous to the peritoneal coat and begins on the opposite side by passing through all the coats from the peritoneum to the mucous and back on the same side from the mucous to the peritoneum. This is repeated on alternate sides until one-half to two-thirds of the stomach is closed. The cut margins now approach the transverse holding clamp so closely that inversion cannot be accomplished; this clamp is removed and the bayonet clamp, which grasps the upper part of the stomach to the left of the cardia, is depended on during the completion of the suture. A half dozen mattress tension sutures of medium sized linen are now placed, turning in the catgut row, and over this a continuous Cushing suture of fine linen makes all secure (Fig. 72).

Step 8: Restoration of gastro-intestinal continuity is best made by a posterior-suture gastrojejunostomy with the jejunum passing to the left and as short as will permit the intestine to reach the stomach pouch without tension. In some cases the remaining pouch of the stomach is so small that anterior gastrojejunostomy on an 18-inch loop, the jejunum running to the right, can be done more easily and quickly, and has given equally good results (Fig. 73).

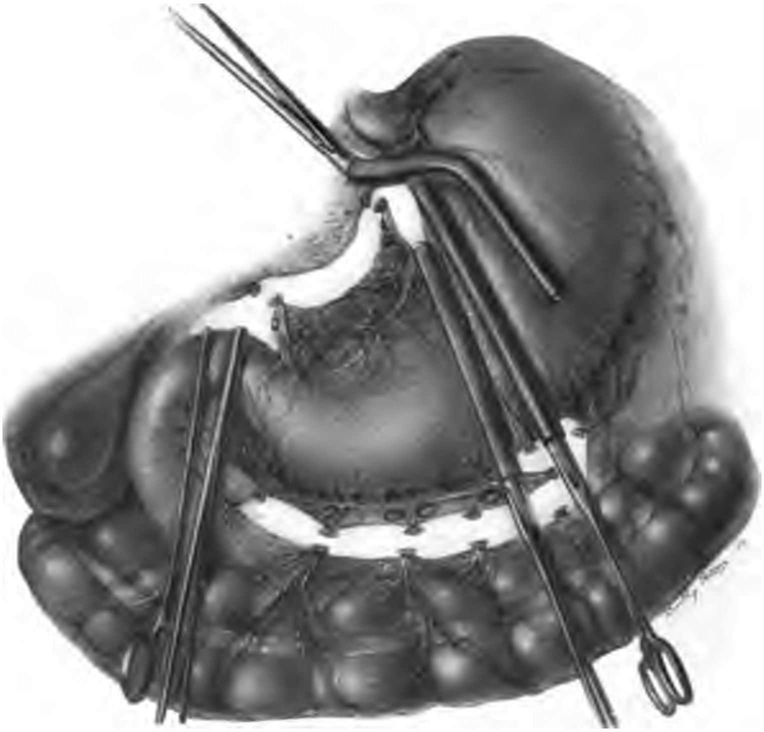

Fig. 72.—Clamps placed on the stomach and duodenum, isolating the pyloric end and lesser curvature.

In doing the anterior gastrojejunostomy we have usually followed the method of Hartmann, *i. e.*, the two-row suture method, but in addition, as Hartmann recommended, stitching the intestine to the stomach pouch an inch above the proximal side with a mattress suture. A second mattress suture is placed ¾ inch on the distal side attaching the jejunum to the tip of the stomach pouch. This prevents the jejunum from kinking on the gastrojejunal opening. Some operators make the gastrojejunostomy as the first step of the resection. We have done so on a few occasions. It is the rule, generally, that cancerous disease should be removed regardless of consequences and the repair made to fit the individual case. The gastrojejunostomy, if made primarily, may not always be at just the right point after the eradication of the disease. In selected cases the Kocher method of joining the duodenum to the stomach can be used, inserting the cut end of the duodenum into the posterior wall of the closed pouch of the

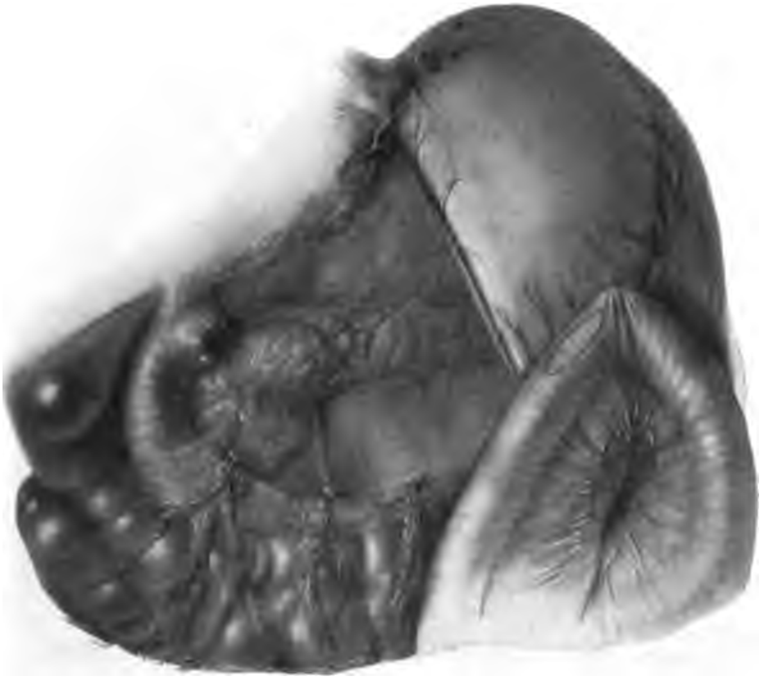

Fig. 73.—Restoration of gastro-intestinal continuity by an anterior gastro-enterostomy, which may be used in place of the posterior operation when the remaining stomach pouch is very small.

stomach. We have used the Kocher method, but, generally speaking, it is not as satisfactory as the Billroth No. 2 method, *i. e.*, closing both the end of the duodenum and stomach and making an independent gastrojejunostomy. The Billroth No. 1 method, *i. e.*, direct union between the cut end of the duodenum and gastric pouch, cannot often be used in malignant disease, although for benign disease, especially hour-glass ulcer, transverse resection in continuity and direct suture, give excellent results.

Some eminent surgeons believe that in serious cases we should do the gastrojejunostomy at one time, and after the patient has had an opportunity to pick up as the result of better feeling, to resect the stomach. We have followed this plan on two occasions, making the resection about two weeks after the gastrojejunostomy. In advanced disease gastrojejunostomy seems to be nearly as dangerous an operation as complete resection, and because of the sloughing masses in the stomach, gastrojejunostomy does not furnish the rapid relief which is desired. Again, when the patient has recovered from his first operation he is inclined to procrastinate, or to refuse a second operation.

In regard to the question of shock in these debilitated individuals: The patient is given a moderate dose of morphin preliminary to anesthesia, which should be maintained to the very lightest degree during the visceral stage of the operation, as no pain is experienced at that time. As a rule, the operation can be completed in from forty-five minutes to an hour and ten minutes, unless some complication arises. After operation the patient is kept warm and is put in the semi-sitting posture. If much debilitated, he is given 10 to 15 minims of camphorated oil hypodermatically every four hours for several days. From 4 to 6 quarts of saline solution are given the first twenty-four hours by the Murphy method of rectal proctoclysis. Two nutrient enemas are given in twenty-four hours for the first three or four days, by which time the patient will be able to take a sufficient amount of liquid nourishment by mouth. A moderate amount of hot water is allowed in the stomach from the start if borne well; after the first twenty-four hours, tea, broths, etc., may be given. Occasionally some blood and gastric secretion will accumulate in the stomach pouch in the first two days. This should be gently removed with a tube and the stomach irrigated with hot water.

Operative Mortality of Pylorectomy and Partial Gastrectomy.—In the 266 resections up to January 27, 1910, there were 34 deaths, or 12.4 per cent. During the year 1909 there were 46 resections with 4 deaths, 8.6 per cent. mortality. This includes every case dying in the hospital, without regard to the length of time following operation, and it includes all the early cases in which the mortality was high. In a way, this is hardly fair to the statistics, as many of the patients were in wretched physical condition at the time of operation, and some of these lingered along for weeks, dying eventually from exhaustion. The postmortem showed the operative field to be in good condition. Yet this method of estimating the operative mortality seems to be the only way in which unprejudiced statistics can be compiled. If one begins to eliminate certain cases, it is difficult to tell just where the line may be drawn fairly. While the operation is one of considerable magnitude, if the patient is in good condition the mortality is certainly under 5 per cent., and to a great extent the deaths are due to the patient's condition rather than to the operation itself. This brings up the question whether resection in advanced cases is worth the risk. I think it is. It should be borne in mind that these patients are usually admitted to the hospital with obstruction of such degree that the possibility of life is reduced to a few days or weeks. Gastrojejunostomy, with nearly the same mortality as resection in cancer, does not give great relief in these advanced cases owing to the discharges from the sloughing mass, which pass downward into the intestinal tract and cause serious changes in metabolism, as contrasted with the patient's condition after resection of the cancerous stomach.

TABLE 3.—OPERATIONS FOR CANCER OF THE STOMACH FROM APRIL 21, 1897, to JAN. 27, 1910

St. Mary's Hospital Records

Total number	627
Explorations—Hopeless condition	206
Gastrojejunostomies	169
Gastrostomies	26
Excision of ulcer (with cancerous change)	2
Resection for cancer	224
	627

PATHOLOGIC RELATIONSHIP OF ULCER AND CARCINOMA OF THE ALIMENTARY CANAL*

By LOUIS BLANCHARD WILSON and BYRD CHARLES WILLIS

Introductory.—Any line of investigation which promises assistance in combating the spread of cancer is worth while. For, discounting to the utmost government census figures everywhere, there yet remains the facts, first, that cancer is increasing materially in relation to the total number of deaths from all causes, and, second, that it is increasing materially in relation to the total number of living. Speaking broadly, it is probably increasing more rapidly than any other of our diseases. And this increase is greatest in the most prosperous nations and in the most prosperous classes within such nations. Further, it attacks individuals at their highest productive period. It attacks particularly the primary organs of perpetuation of the individual, *i. e.*, the reproductive apparatus. In the male approximately two-thirds and in the female one-fourth of all cancers develop in the alimentary canal, while one-half of all cancers of the female are in the reproductive organs.

It seems to us that in our consuming interest in the initial excitant or ultimate cause of cancer there is a possibility of our losing sight of the importance of the study of the tissue conditions of the affected individual. When the relationship of bacteria to infectious disease was first brought to the attention of the scientific world, for a long time the specific germ was the chief object of study. Experience soon taught us, however, that in combating infectious diseases it is even more important that we familiarize ourselves with those conditions of the body by which nature combats disease. We are apt to forget that if we knew to-day the primary irritant in carcinoma as well as we know the leprosy bacillus, we might still be almost as helpless as we now are in controlling the disease. We would still be under the necessity of investigating most carefully the anatomic and physiologic condition of the tissues which permit the primary excitant, whatever its nature, to become effective.

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* Read in the Section on Practice of Medicine of the American Medical Association, at the Sixty-first Annual Session, held at St. Louis, June, 1910. (Reprinted from "Jour. Am. Med. Assoc.," Sept. 10, 1910, vol. lv, pp. 921–923.)

Clinical Evidence.—From the purely clinical standpoint, probably the most salient points which present themselves in relation to tissue susceptibility to carcinoma are the following:

1. Carcinomata of the reproductive organs in the female—one-half of all cancers in this sex—occur principally at the age when the reproductive organs have begun their regressive changes.

2. Carcinomata of the alimentary canal—two-thirds of all cancers in the male—follow in the great majority of cases chronic non-cancerous irritation.

Anatomic Evidence.—When once removed from the body, tumors of the alimentary canal are of relatively easy study, because of the comparatively simple anatomic relationships; the thin walls with well-defined laminæ and simple glands. The lips, mouth, and anus are, of course, exceptions to this. When we examine carcinomata of the alimentary canal, we find them in a great majority of cases developing on epithelial tissue which has been displaced either by ulcerative changes or by diverticula. An ulcer of the mucous membrane of the alimentary canal shows within its base usually only granulation tissue, all of the tubular glands having been destroyed. At the margin of the ulcer is an overhanging border consisting of hyperplastic mucosa. Where this hyperplastic area meets the eroded base is a ring in which are found islets of tubular epithelium which have been cut off from their connection with the outer world by bands of scar tissue.

The center of the ulcer, filled with granulation tissue, is almost always on a level with that of the normal base of the mucosa, within which is the ring containing segregated epithelium. The tendency of such islets of segregated epithelium is toward destruction by the cutting-off of their blood-supply by scar tissue. In a careful study of these cell inclusions, however, we frequently find that many of the islets instead of degenerating show more or less proliferation of their cells. This is evidenced by their apparently increased number in a cross-section, by their mitotic figures and their dividing nuclei. Such inclusions are of frequent occurrence around the borders of all ulcers of the stomach, duodenum, gall-bladder, appendix, and large intestine. It is probable that the proliferation of the epithelium within such inclusions is frequently stopped by the cutting-off of the blood-supply, and that degeneration results. When, however, we study many lesions of this type, particularly within the stomach, we find that certain groups of epithelium show not only proliferation of their cell contents, but that the proliferating cells are infiltrating the surrounding tissues; that this is a true passage of the epithelium into the previously formed scar tissue. That the picture is not due to the presence of remains of included epithelium which has been only partially cut off from its normal site there can be no doubt in the mind of one who studies the sections with proper care. The epithelial cells which are insinuating themselves between the bands of fibrous tissue are not old degenerating cells, but are cells which are proliferating, as is shown by their staining reactions and their dividing chromatin. It is noteworthy that this proliferation is usually most marked in the portion of the epithelium-bearing ring which is furthest removed from the center of the ulcer with its scant nutrition. More than 70 per cent. of all of our cancers of the stomach give satisfactory gross and microscopic evidence of previous ulceration and isolation of epithelium, while the evidence is equally clear in our cancers of the gall-bladder. We have seen at no point within the alimentary canal any evidence that surface irritation, however prolonged, has anything to do with providing conditions suitable for the development of carcinoma. It seems to be a *sine qua non* that the portions of epithelium shall be displaced from their normal relationship, and this does not occur where superficial irritation alone is concerned, but only in ulcers and diverticula.

The relationship of small diverticula of the alimentary canal to carcinoma has not been fully appreciated, partly because the presence of the diverticula themselves has been but recently called to our attention. When we* placed on record our five cases of diverticulitis of the sigmoid three years ago, there were on record only eighteen previous cases. One of these† presented a carcinoma of a diverticulum. The number of cases of diverticulitis has increased during the subsequent three years until there are now on record nearly one hundred cases. We have added five new ones to our list. In these five, two are cases in which the operation was made primarily for well advanced carcinoma, and diverticula were found in the base of the carcinoma. The epithelium within small diverticula is frequently quite as completely occluded from connection with the interior of the viscus as is that lying at the base of an ulcer of the stomach. Here, as in the isolated islets of epithelium within the stomach, the tendency of the segregated cells is to degeneration from reduced nutrition. They do, however, occasionally proliferate greatly, and, as we have shown in three of our nine cases, they may also infiltrate and thus form carcinoma. When one goes over a number of cases of carcinoma of the sigmoid, one is struck with the patch-like or ring-like character of all of the lesions, except those of the most advanced type. This is exactly the sort of tumor which one would expect to find developing on isolated epithelium within diverticula, and the two tumors whose origin, as we have demonstrated, has been on diverticula, are of exactly this type. In order to show the presence of diverticula in carcinomata of the sigmoid which have advanced to any extent, it is necessary to use the utmost care in examining the specimen while it is still fresh.

Sometimes with fresh specimens this can be done by very gently probing from the inner side of the tumor, or, better still, by carefully slicing off the tumor from the serous surface and parallel thereto, and examining underneath each slice as it is removed. We are satisfied from our experience that many cases of carcinoma of the sigmoid and rectum have had their origin on diverticula which have been overlooked at operation, even when they were still undestroyed by the tumor.

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* Mayo, Giffin and Wilson: "Surgery, Gynecology and Obstetrics," July, 1907, pp. 8-15.

† Hochenegg: Proceedings Thirty-first Congress German Surgeons.

In the last 5,000 appendices which have been removed at our clinic we have discovered twenty-two primary carcinomata. In reviewing these recently, MacCarty and McGrath * have noted that all of these tumors have occurred in the tips of appendices which had been previously obliterated. This obliteration in all cases extended well proximal to the tumor, and showed the formation of scar tissue at some point proximal to the tip in greater quantities than in the tip itself. The glandular epithelium of the tip of the organ has been separated from the lumen of the cecum. Such epithelium is frequently found to show hyperplasia or adenomatous proliferation. In the twenty-two cases which we have found, however, there is much more than this, viz., an infiltration of the deeper layers of the appendix, resulting in unmistakable primary carcinoma.

In the tough fibrous stroma of the border of the lips it is difficult to make out microscopically any evidence of flat-cell inclusions. The lips of practically all adults have been so frequently subjected to traumatic scars, ulcers, etc., as the result of nutritional disturbances that it would seem probable that such inclusions of the epithelium are frequently present. Carcinomata of the lip, however, usually come to the clinic so late that all microscopic evidence of their previous benign ulceration has disappeared, though the clinical histories recite such evidence in an unmistakable manner.

Within the mouth the relationship of ulcerating leukoplakia to subsequent carcinoma is established on a very firm clinical basis, though here, as in carcinoma of the lip, the patients most frequently come to operation at a period when all microscopic evidence has been swallowed up in the advance of the secondary disease.

To summarize, then, the results of our studies, we may say that

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* MacCarty and McGrath: "Jour. Am. Med. Assoc.," Aug. 6, 1910.

in the alimentary canal, whatever may be the essential irritant—microörganisms, ferment or what not—the fact remains that in a very high percentage of the cases there is microscopic evidence backing up clinical evidence that the carcinomata have developed on epithelial cells which have been previously isolated from their normal surroundings, either by the formation of diverticula or by being cut off by scar tissue in ulcer bases. This statement has in it neither support nor contradiction for any hypothesis as to the character of the essential irritant in carcinoma. Just as we must have tissue cut off from sufficient blood-borne oxygen in a punctured wound in order to permit development of the tetanus bacillus, so it seems that in the alimentary canal we must have tissue which is cut off from its relationship with the outside world in order to have the development within it of whatever may be the essential irritant of carcinoma. Whether this isolation of epithelium is a primary necessity for the formation of carcinomata throughout the body is another question. Certain it is that a similar condition exists in the female breast which is undergoing regression. Certain it is that similar conditions exist in the uterus, with its partially shed epithelium, with its frequent erosions, and with its regressing mucosa. Certain it is that a similar condition exists in the prostate as the result of inflammatory changes segregating islands of epithelium. Within the kidney true carcinomata are frequently associated with the ulcerated process secondary to nephrolithiasis, while the so-called "hypernephromata," on the other hand, are apparently the result of the proliferation of tissue which has failed to become connected embryologically with the portion of the tubular epithelium which is in direct relation with the renal pelvis. Indeed, as we look over the whole field of carcinomata, we must agree with Adami that these tumors are the result of the development on either postnatally or prenatally displaced cells which exhibit a tendency to revert to the embryonic type.

The clinical bearing of all of this is in teaching the importance of the recognition and cure of those diseased processes which, however benign in themselves, tend to isolate epithelium. There can be no question but that chronic ulcers of the mouth should be promptly cared for. Ulcers of the stomach should receive the most minute attention. The obliterating appendix, however innocent its look, should invariably be removed when found. Diverticula of any portion of the large intestine should be treated by complete removal rather than by a drainage of the abscesses which may be formed about their extremities. The greatest difficulty, of course, is in the early diagnosis, but that is without the province of this paper.

PATHOLOGIC MATERIAL STUDIED

Cancers of lip	167
Cancers of mouth and tongue	46
Cancers of esophagus	2
Cancers of stomach	189
Cancers of gall-bladder	15
Cancers of appendix	22
Cancers of cecum	20
Cancers of remainder of colon	42
Cancers of rectum	67
	570

SUMMARY

Of the cases of cancer of lip, 30 per cent. gave evidence of previous isolation of epithelium.
Of the cases of cancer of stomach, 67 per cent. gave such evidence.
Of the cases of cancer of gall-bladder, 33 per cent. gave such evidence.
Of the cases of cancer of appendix, 100 per cent. gave such evidence.
Of the cases of cancer of cecum, 10 per cent. gave such evidence.
Of the cases of cancer of colon, 40 per cent. gave such evidence.
Of the cases of cancer of rectum, 3 per cent. gave such evidence.

Conclusions.—1. The relationship to cancer of simple chronic irritation of the unbroken free surface of the mucosa of the alimentary canal, as indicated by clinical data, is not readily demonstrable pathologically.

2. Scar tissue at the bases of ulcers, obliterations of the lumina of appendices, and diverticula segregate portions of mucous epithelium from the neighboring epithelium and from the lumen of the alimentary canal.

3. These portions of segregated mucous epithelium tend (*a*) to degenerate from pressure and diminished blood-supply, or (*b*) to proliferate and infiltrate the surrounding tissues, thus forming cancer.

4. These islands of segregated epithelium probably should be regarded as points of least resistance only, and requiring the presence of other factors for the production of carcinomata.

DISEASES OF THE STOMACH AND DUODENUM FROM A SURGICAL STANDPOINT*

By WILLIAM J. MAYO

Few people with chronic disease die from the malady with which they suffer during life. Postmortem information as to the causes of death has usually disclosed that death was due to secondary complications and terminal infections. The postmortem did not present a true picture of the disease as it existed during the curable period because it could not show the living pathology.

Postmortem findings have, however, given us accurate information as regards certain diseases, such as acute perforation of the stomach, because the perforation often led directly to the death of the patient; but in chronic gastric diseases, unless they terminate fatally from some acute condition, we are not so greatly benefited by postmortem examinations.

The contributions of surgery to further a better understanding of diseases of the stomach and duodenum have been of the first importance and have revolutionized our ideas concerning these conditions. This newer knowledge will necessitate a readjustment upon a modern basis of many of our former opinions.

Surgical measures have illuminated pelvic cellulitis and pelvic hematocele, showing them to be tubal infections and extrauterine pregnancies. Phlegmonous enteritis, obstruction of the bowels, general septic peritonitis, perityphlitis, and a host of other supposed conditions, were proved by surgical means, in the majority of instances, to be the result of appendiceal inflammations. In the same manner, diseases of the biliary tract, pancreas, and other obscure corners of the abdomen have had their true pathology brought to light.

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* Read before the Kings County Medical Society, Brooklyn, N. Y., Oct. 18, 1910. Published simultaneously with the "Journal of the New York State Medical Association." (Reprinted from "The St. Paul Medical Journal," Jan., 1911.)

The stomach has been credited with a host of diseases which it never possessed and has received an amount of treatment for supposititious conditions that is of little credit to the medical profession. These mistakes have been due, mainly, to certain fundamental misconceptions as to the function of the stomach, its relation to diseases in general and especially to those of the digestive tract.

In this respect the stomach resembles the urinary bladder, the supposed diseases of which have been so greatly reduced since the cystoscope, ureteral catheter, *x*-ray and other means of direct inspection have come into general use. Tuberculosis of the kidney masqueraded as intractable cystitis, the relatively unimportant bladder involvement giving rise to nearly all of the symptoms and securing for the patient a large amount of unnecessary treatment.

Why was the male so frequently believed to have bladder disease? Because of enlarged prostate, posterior urethritis, and kindred diseases. When stripped of the symptoms it is not responsible for, but which nevertheless give rise to complaint, the bladder itself will seldom be found to be diseased. To a great extent this is true as regards the stomach, which is held responsible for more "complaints" than any other organ in the body, and yet it is not often the real source of the symptoms, but rather the mouthpiece speaking for a host of other organs.

The stomach has several important functions. The first and most important is that of storage. This organ acts like a magazine of a coal-stove, feeding its contents slowly into the intestinal tract for absorption and assimilation. The food, which is more or less mixed with the ptyalin in the process of mastication, lies in the fundus of the stomach in a globular mass from twenty to thirty minutes. The gastric secretions are largely formed in the pyloric end and are stimulated into activity. The mass gradually becomes mixed, and passes, a portion at a time, into the pyloric antrum, where it is ground up and ejected through the pylorus.

When a certain degree of acidity exists in the pyloric antrum, the pylorus opens and the chyme passes into the duodenum, and when a certain degree of acidity takes place in the duodenum, the pylorus automatically closes. It should not be forgotten that the duodenum has the paramount right over the stomach in the control of the pyloric apparatus, and that this right to control is not confined to the duodenum, but is possessed to some extent by all the derivatives of the midgut from the common duct to the splenic flexure of the colon, and accounts for gastric disturbances in the presence of intestinal disease.

The mechanical effect of the action of the stomach upon the food-mass, is much more important than the chemical effect. The gastric juices, which consist of a dilute solution of hydrochloric acid, pepsin, and certain other secretions, aided by the gastric musculature, break the food-mass and form it into a homogeneous whole. Motility is the most important gastric function, and anything that interferes with this function causes marked disturbances of the stomach. We have paid relatively too much attention in the past to the chemistry of the digestive process, and too little to the more important function of motility.

In over three hundred gastrectomies in which the entire pyloric end of the stomach was removed, necessarily reducing subsequent secretions of hydrochloric acid and pepsin to a minimum, we have never had any complaint of gastric distress from the patient after the operation, if there was unobstructed opening for the passage onward of the food. This is also true of the relief afforded patients with obstruction when gastrojejunostomy is performed, although the continuous presence of alkaline biliary and pancreatic secretions following operation must act to neutralize the gastric secretions and interfere with all the gastric functions except that of motility.

The stomach may be described, anatomically, as a muscular organ with temporary storage function which enables its possessor rapidly to place in its cavity a considerable quantity of food-products for the slower process of digestion and absorption, rendering continuous feeding unnecessary.

The stomach has two well-defined compartments: First, the fundus, into which the food is immediately received and temporarily contained. This part of the stomach does not have a great amount of secretion, and is more or less under the control of the cerebrospinal nervous system; that is, we are conscious to a considerable extent of the condition of its cavity, by the feeling of repletion after the full meal, hunger, etc. Second, the pyloric antrum, where the secretions are most active and the muscular action most powerful. Of this part of the stomach we have comparatively little knowledge or conscious control. In many of the lower animals a sphincter exists between these two cavities which is called the antral sphincter. If this sphincter ever existed in man, it has now disappeared, although physiologic contraction takes place at that point.

The first 4 inches of the duodenum, the part lying proximal to the common duct, originates, like the stomach, from the foregut, and its functions and diseases are those of the stomach rather than of the intestine, although, morphologically, it resembles the small intestine.

The control of the intestinal tract, which includes the antrum of the stomach, is primitive, and is obtained by means of internal secretions. This control existed before the cerebrospinal nervous system had developed, and it continues to have paramount influence over the digestive and assimilative functions. This method of control acts by chemical stimulation through the blood-stream and also through the sympathetic ganglia. It may be compared to the hand and fingers which play upon the piano; the internal secretions being the active agents, and the sympathetic nervous system the coördinating body. The plexuses of Meissner and Auerbach, which are derived from the cerebrospinal as well as the sympathetic nervous system, have comparatively little influence over digestion and assimilation. The fundus of the stomach was a late development, and is consequently more or less under the control of the cerebrospinal nervous system; it follows, therefore, that the stomach is the place where derangements of the entire intestinal tract between the beginning of the antrum and the splenic flexure may reach the consciousness of the individual.

This is the reason why strangulated hernia, appendicitis, gallstones, intestinal tumors, intussusception, etc., cause nausea and vomiting and pain in the stomach; the distress arising from nature's endeavor to secure rest by means of the so-called "pylorospasm," which acts to prevent food from passing out of the stomach. If food remains too long in the stomach, it interferes with both the storage and digestive functions; the secretions become changed and a chain of symptoms are set up which are spoken of as dyspepsia, and indigestion. If we place too great reliance upon laboratory findings, we may be influenced to consider these purely secondary conditions as actual diseases of the stomach, and to name them in accordance with some prominent symptom. This has been done over and over again.

Looked at pictorially, stomach disturbances may be divided into four groups:

First, where the stomach is disturbed by general conditions, and where, for a time, the gastric distress obscures the actual disease. We have all had the humiliation of treating the patient for stomach trouble who was suffering from cardiac insufficiency or the gastric manifestations of arteriosclerosis; of giving pepsin and hydrochloric acid to a patient for supposed dyspepsia who had chronic nephritis; of making a diagnosis of gastric ulcer because of gastric hemorrhage the result of cirrhosis of the liver, and of treating the stomach because of the vomiting of pregnancy. Not a few patients with gastric crisis due to locomotor ataxia have been subjected to gastrojejunostomy for supposed gastric ulcer. These are a few examples of mistaken diagnosis due to the effect of systemic disturbances upon the gastric function.

Second, gastric disturbances due to a group of diseases more or less intimately associated; for example, atonic dyspepsia, prolapse, and gastric neurosis. Atonic dilatation gives rise to a splashy stomach, the abdominal walls are flaccid, and the abdominal aorta may be so plainly felt that the unwary are led to a diagnosis of aneurism. Prolapse of the stomach is, in the majority of cases, a part of Glénard's disease, and although bismuth and *x*-ray photographs show a marked downward displacement, there is usually very little mechanical interference with the progress of food. Gastric neurosis is an exceedingly common condition, and two of the many types are worthy of mention: the female from seventeen to twenty-four years of age, who vomits as soon as food is taken into the stomach, and the male of middle age with constant gastric complaint of the hypochondriac type. Atonic dilatation and prolapse are seldom benefited by operation, and surgery is much too serious an agent to be used as a means of psycho-therapeutics in gastric neurosis.

Third, the disturbances of the stomach due to appendicitis, gall-stones, intestinal tumor, intussusception, intestinal tuberculosis, etc. These have already been discussed. As a rule, surgery must be invoked to secure relief in this class of cases.

Fourth, a small group of cases in which the stomach is actually involved in diseases that can be demonstrated surgically, of which ulcer and cancer are the most frequent examples.

Mistakes in diagnosis are oftener the result of a lack of examination than of a lack of knowledge. The first step in the diagnosis of supposed disease of the stomach should be a general physical examination, in order to eliminate causes of gastric distress which originate in diseases outside of the digestive tract. We should then eliminate the non-surgical diseases, *i. e.*, atonic dilatation, prolapse, gastric neurosis, etc. Next in order come diseases of the digestive tract outside of the stomach which may give rise to the symptoms. All of these possible conditions must be eliminated by careful and methodic examination before taking up the question of diseases which can be rightfully attributed to the stomach.

When Kussmaul adapted the stomach-tube from the stomach-pump in 1867, and applied it to the diagnosis and treatment of gastric disorders, a great step was made in advance. This device imparted some knowledge of diseased processes and changed functions in the interior of the stomach, as evidenced by secretions, food, and other material removed by the stomach-tube. However, since the days of Kussmaul, and his collaborators, the amount of information gained in this way has been small. A great amount of labor has been expended in examining the gastric secretions, test-meals, etc. The results have often been disproportionate to the amount of effort, and too frequently have been accepted at a fictitious value. In our disappointment over the failure of the laboratory to establish definite diagnosis in many conditions of the stomach, we are going too far in our criticisms. Moreover, the laboratories have not failed, but we have failed to interpret the laboratory findings rightly. It is only in contrasting actual conditions found through surgical inspection with those of laboratory and other diagnostic findings that we are enabled to check up and obtain a proper valuation of the various signs and symptoms of gastric disease.

In showing the size, shape, and position of the stomach, the *x*-ray has been of some service. The gastroscope has not yet been perfected so that it can be put to practical use, and the diaphanoscope gives unimportant results.

In making a diagnosis of disease of the stomach, the history of the patient is of the first importance, particularly in relation to early symptoms, when characteristics of disease are not obscured by secondary complications. The relation of food to the production of the symptoms should be carefully noted. After the history, comes inspection, palpation, and accurate location of points of pain and tenderness. Next in importance is the stomach-tube: (*a*) To draw off the stomach-contents. A careful gross examination should be made of the material. In ulcer of the stomach the organ often contains a considerable quantity of sour, pungent fluids, greatly in contrast to the sickish, coffee-ground liquids so often found in cancer. If there is obstruction, the contents will contain food-remnants which will be readily detected macroscopically. (*b*) Distention of the stomach with air by means of the Davidson syringe, in order that its shape, outline, and position may be demonstrated. At times a tumor will be brought into a situation where it can be palpated, when it might not otherwise be discovered. (*c*) Laboratory examination of the stomach-contents. A determination of the amount of acids has considerable value, but only when taken in conjunction with clinical findings. High acids, with hypersecretion, give testimony in favor of benign disease, but the converse is less true as regards malignancy. Occasionally a piece of tissue may be obtained for microscopic examination.

Free or occult blood, either in the gastric contents or in the stool, is an aid in differentiation, but is of less importance than is popularly believed.

Chronic ulcer of the stomach and duodenum. Twenty-five years ago, when I was a medical student, ulcer of the stomach was considered an exceedingly common condition, and one easily diagnosticated. Ulcer of the duodenum, on the other hand, was believed to be exceedingly rare and difficult to diagnosticate. Ulcer of the stomach was supposed to occur in the female in more than 60 per cent. of cases, and in the male in less than 40 per cent. These ulcers were usually thought to be multiple. The main reliance in diagnosis was the fact that the patient took food and had pain which was relieved when the stomach was empty. With this condition it was believed that the patient had ulcer.

What has surgery demonstrated to be the actual facts? First, that in at least 75 per cent. of the cases the ulcer is not in the stomach, but in the duodenum. As to the sex, 80 per cent. of the patients upon whom we operate for ulcer are males. Multiple ulcer exists in less than 8 per cent.

In observing the relation which food has to ulcer, we find that, previous to the stage of obstruction, food gives relief to pain, which is most intense when the stomach is empty. The patient takes food, milk, or other diluent, or bicarbonate of soda to get relief by neutralization of the retained acid secretions. The patient with other characteristic stomach disturbances who wakes up at a certain hour of the night with bitter, acid, sour feeling in the stomach, and raises up a mouthful or two of this burning secretion, or is compelled to take food or drink for acidity, in the majority of instances will be found to have ulcer.

It is evident that a large number of supposed ulcers in the past were in the nature of disturbances classed under the head of (1) general diseases affecting the stomach, (2) atonic dilatation, prolapse, and *gastric neurosis,* (3) disturbances of the stomach due to diseases of the intestinal tract.

One of the peculiar features of chronic ulcers of the stomach and duodenum is the deceptive improvement which is so often mistaken for cure, and which has apparently little relation to the actual condition of the ulcer itself. After serious symptoms lasting for some weeks, the patient may have complete relief for weeks or months, and yet if operated upon during the quiescent period the ulcer will almost regularly be found open and unhealed. The supposed cures of chronic ulcers of the stomach and duodenum may be compared to the supposed cures following each attack of recurring appendicitis or gall-stone disease.

What shall we do with chronic calloused ulcers of the stomach and duodenum? I believe the unprejudiced observer must come to the conclusion that operative relief is indicated after a reasonable amount of medical treatment has failed to give a permanent cure. Calloused ulcer of the stomach should, if possible, be excised on account of the serious cancer liability, and if necessary for drainage, a gastrojejunostomy should be made in addition. Ulcers of the duodenum do not often become malignant and gastrojejunostomy is a most reliable procedure in these cases.

Cancer of the stomach is the most common of all cancers in the human body, as no less than 30 per cent. occur in the stomach. They are amenable to surgical treatment, with good prospects of cure if patients can be submitted to operative treatment sufficiently early in their development. Twenty per cent. of our cases of cancer of the stomach which were submitted to radical operation more than three years ago are alive and well; some of them have been well for more than nine years. Cancer of the stomach does not produce symptoms as cancer during the curable period, and it is only when the situation of the growth introduces mechanical elements which interfere with the progress of food in the stomach, or when a tumor can be felt, or some other fortuitous circumstance occurs, that we are able to make a diagnosis in time for successful operative procedure. It is in cancer of the stomach that the prolonged laboratory investigation has been productive of so much harm—*a scientific but deadly delay.*

I do not believe the general position can be assailed which assumes that all cases in which there is mechanical interference to the progress of food, or a demonstrable tumor, should receive surgical consideration. A suspicion that there is cancer of the stomach should, above all things, lead to surgical consultation. These cases have no more business in the medical wards than has cancer of the lip, breast, or uterus.

A high degree of technical skill is not required in order to palpate a gastric tumor or to make a diagnosis of mechanical obstruction. If the patient is told to take with his evening meal some soup containing half-cooked rice and a penny's worth of raisins, remnants of this food will be found in the stomach the next morning if obstruction exists.

Modern surgical methods have developed a safe technic for the radical removal of gastric cancers with good prospects of cure. It only remains for the profession to recognize the facts, and *give the patient a chance.*

SURGICAL CURE OF CANCER OF THE GASTRO-INTESTINAL CANAL*

BY WILLIAM J. MAYO

The cancer problem is the most important which confronts mankind, and while we are perhaps no nearer its final solution so far as knowledge of its direct cause is concerned, recent investigation has at least cleared away some of the fog of supposition and superstition which has surrounded the subject in the past.

All forms of animal life are liable to some form of cancer, and the statements made by travelers that aboriginal races do not suffer the disease is based upon inference and incorrect observation. The health margin of primitive people is very narrow, and the victims of cancer among them succumb quickly in the struggle for existence. The disease, therefore, is but little in evidence, rather than absent.

It has been definitely shown also that cancer is not hereditary, although it cannot be said positively that the soil in certain families is not more favorable to its development than it is in others. The presumptive evidence is against direct contagion by inoculation, although the Scotch verdict of "not proven" best describes the present status of our knowledge.

During the last ten years an enormous impetus has been given to the study of cancer by the foundation of research laboratories. In this country they have been endowed by private philanthropy, as in Boston, or through state aid, as in Buffalo, New York. In England the active work is represented by the Imperial Cancer Commission and the Middlesex Hospital. The latter institution is to be associated with a third cancer institute to be carried out by the Barnato Fund. In Germany the Heidelberg Cancer Institute, under the charge of Czerny, is the most notable.

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These various institutions for cancer research have been vastly useful, not only in clearing away venerable cancer legends, but in that they have accentuated certain previously known clinical facts which had not been recognized at their full value.

It is worth while to consider the bearing of several of these investigations upon the radical treatment of cancerous disease.

First: Johann Orth and others have shown that all there is of cancer is in the cancer-cell, that each cell contains within itself the possibility of unlimited cell division, and that the stroma of the cancer, which was for a long time considered a necessary part of the cancerous process, was, in truth, but the measure of nature's resistance, and represented an ineffectual effort to stem the tide of cancerous invasion. Viewed from this standpoint, we can readily see why scirrhus is slow in its development, and why contracting cancer of the mamma, in which the stroma is so greatly in excess of the cell, may by slow strangulation maintain an efficient barrier against the disease for many years. It also explains the action of various chemical and thermic agents which have proved useful in the palliation and in checking the spread of the cancerous process. While the individual affected by the disease may not be able effectually to resent the insult of cancer growth which in him is represented by a high-cell proliferation with a small amount of stroma, yet his tissues will quickly resent the insult of a burn, and the resulting scar tissue acts as a barrier, which, like the stroma of the slower growths, temporarily prevents its spread.

Second: What might be called the triumph of modern investigation is the proof that all cancers are at one time local, and that in this period they are curable. This fact should lead us to strive more earnestly for a recognition of the early manifestations and the eradication of the disease in its curable period. That form of skepticism which urges that all cancers are primarily constitutional has been the cause of enormous loss of life. Fortunately this will no longer serve to excuse ignorance or inefficient methods of diagnosis, and it is well for us to understand, too, our moral responsibility for unnecessary delay. The practitioner of the future who procrastinates while watching the growth of a tumor will be held accountable to the general public, and he can no longer shelter himself behind venerable but exploded theories. Finally, it leads to the conclusion that there is no known cure for cancer except removal while it is still a local process, and that all cancers in all parts of the body are necessarily surgical from their inception, and that a suspicion of it should lead to a surgical consultation.

Third: Heidenhain was one of the first correctly to appreciate the relation of the lymphatics to the spread of cancer, and his paintaking research work in cancer of the breast, still remains a monument to his name. He made from 11,000 to 17,000 serial microscopic sections from eleven breasts, practically converting the whole field into one gigantic microscopic picture, and demonstrated for all time the manner in which cancer spread through the lymphatics. The more recent investigations, particularly those by Handley, of the Middlesex Hospital, have served to accentuate and extend Heidenhain's views.

It has been shown that the older the patient, the slower the development of the cancerous process. The reason for this was pointed out some years ago by C. H. Mayo. In a study of the lymphatics he demonstrated that the lymphatic system reached its height in adolescence, and that in advancing life the lymphatics underwent a progressive atrophy, and this lack of lymphatics accounted for the benign course of the disease in the latter decades of life as contrasted with the riotous spread of the malignant process in the young.

The practical bearing of our modern understanding of the relations of the lymphatics to cancer has already borne fruit and sounded the death-knell of the caustic and paste in the eradication of the disease. Admitting that these agents do in a way remove the local focus, of what avail are they against the lymphatic spread? Modern operations which include a wide area about the local source, and removal of the tributary lymphatics, have enabled Halsted and others, by special technic, to give 50 per cent.

of five-year cures in cancer of the breast, as against 14 per cent. of the older writers with their limited local operations. Wertheim shows 51 per cent. of five-year cures in cancer of the cervix, as against 8 per cent. of the older surgeons.

Fourth: Bashford, in his address on cancer before the International Medical Congress, 1909, again calls attention to the remarkable influence of chronic irritation on breaking down local resistance and thereby permitting cancer invasion—a clinical observation which has heretofore been about our only known fact in its etiology. The chronic irritation factor is evidenced in many ways: for example, the lip cancer of the smoker and its preponderance in the male; the betel-nut chewer of both sexes and cancer of the mouth; gall-stones in the production of cancer of the gall-bladder; ulcer of the stomach and its relation to gastric cancer; the "chimney-sweep" cancer, and many others too numerous to mention. All of this leading up to the most important point in prophylaxis—the avoidance of the sources of chronic irritation and the relief of such conditions when present, as they can be truly said to be a precancerous condition awaiting only the unknown factor to set loose normal limitations upon cell reproduction. In this connection Keen has pointed out the necessity of a careful watch for evidence of degeneration in moles, warts, nevi, and congenital defects of all kinds, on account of the frequency of secondary cancer.

As a result of our modern conception of the cancer process, there has been an enormous gain in the percentage of cures following operations upon accessible organs,—the lip, breast, uterus, etc.,—where the diagnosis can be made early by direct inspection and palpation; but 75 per cent. of all cancers in the male and 50 per cent. in the female involve the alimentary canal, and are not readily accessible to these direct methods of examination. It is true that by means of the esophagoscope the esophagus can be inspected, and the rectum can be palpated digitally and inspected through the proctoscope, but one-half of all carcinomata in the male, and a somewhat smaller percentage in the female, lie between the cardiac orifice of the stomach and the beginning of the rectum, and therefore cannot be subjected to direct inspection and palpation. By means of the gastroscope, glimpses of the interior of the stomach may be obtained, and the lower sigmoid may be somewhat more adequately inspected by means of the sigmoidoscope. The *x*-ray bismuth method is also being used, and is proving of modest service in the diagnosis of gastro-intestinal disease; yet, after all, these means of diagnosis are of secondary value only.

It may be truthfully said that the diagnosis of malignancy of the gastro-intestinal tract, including the biliary apparatus and the pancreas, is uncertain and often impossible during the stage of local involvement because we cannot directly examine the parts involved, and we have no test which will reliably show the disease by examinations of the blood or secretions. Crile, Elsbury and others, however, are doing research work on hemolysis which promises well, although as yet in the experimental stage.

As could be expected from the advanced stage in which malignant disease of the alimentary canal has heretofore come to operation, the results of surgical treatment have been bad. Billroth's mortality after resection of the stomach was 64 per cent., yet the medical mortality was, and still is, 100 per cent. As a result of these various influences the curious anomaly is still seen, *i. e.*, the patient suffering from cancer of the stomach is considered a medical case and is admitted to the medical wards of hospitals, where he has no chance for his life whatever. There is no more reason why cancer of the stomach should be considered a medical disease than that cancer of the lip, breast, or uterus should be considered medically.

To what extent is this pessimism as to the curability of cancer of the gastro-intestinal tract justified by experience? Are the bad results due to fundamental causes, and therefore unavoidable, or are cancers in this region similar in all respects to cancers in other parts of the body, and the unfavorable results due to the lateness of the diagnosis and operation? I think there can be no question but that the latter view is the correct one.

The following results were obtained with patients operated on by C. H. Mayo and myself in St. Mary's Hospital during the last ten years, from October 1, 1899, to October 1, 1909. During this period 251 gastric resections were made for cancer, with a mortality of 13 per cent. Of these patients, 29 per cent. operated upon more than three years ago who recovered from the operation are alive and well. Two have passed the five-year period and one six and one half years.

No other organ in the body is involved in cancer as often as the stomach. Thirty per cent. of all cancers in the male involve the stomach. Twenty-two per cent. involve the stomach in the female. These statistics are conservative. Some estimates show a much higher percentage, even as high as 50 per cent.

Graham has shown that 59 per cent. of the cases of gastric cancer which came to us gave a clear history of chronic ulcer. From the microscopic examination of the resected portion of the stomach, Wilson was able to demonstrate the development of cancer on ulcer in 51 per cent. of the specimens obtained from gastrectomies. As accounting for this somewhat higher percentage of gastric cancer in men over women, it has been shown in our series that 58 per cent. of true gastric ulcers were in the male sex.

This question of cancer development on ulcer is a mooted point, and is opposed by a number of men who have devoted a great deal of time to the purely non-operative treatment of diseases of the stomach. Their convictions are, I believe, the result of fallacious clinical examinations, and so far as this subject is concerned, the equally fallacious results of postmortem examinations. How is it possible to determine from the examination of a patient dead from cancer of the stomach whether or not ulcer had existed? By the time the patient is dead all evidence would be lost in the extent of the cancer process.

At the present time we have a considerable number of favorable cases in which resection of the stomach for ulcer shows early cancerous development on its margin. This brings up the important point that when the chronic ulcer of the stomach calls for surgical treatment, resection of the diseased area is a wiser procedure than gastro-enterostomy, and leads us to believe, in many of the cases in which cancer has followed upon ulcer within two or three years after gastro-enterostomy, that the cancer was probably present in its earlier stages at the time of the primary operation.

As Deaver points out, what is needed is an earlier diagnosis of cancer of the stomach, and he says most pertinently that the greatest source of delay is the test-meal, and that prolonged and useless laboratory investigation is responsible for the hopeless condition in which so many of the patients present themselves to the surgeon. Without going into the question of the value of the test-meal, and various laboratory tests, I think from a practical standpoint that Deaver is right. Every year in our clinic we subject about 3,500 individuals to gastric examination with analysis of the stomach-contents, and about 10 per cent. of these patients come to operation. Gastric analysis and the test-meal are of importance but not of great diagnostic value. They are valuable just as the temperature and pulse are valuable, but they do not carry with them conclusive evidence during the curable period. They are merely adjuncts to the clinical side, and prolonged delay on account of their supposed value is to be deprecated.

There are two diagnostic factors of great surgical import within the reach of every physician, and a proper recognition of their value will bring surgical cure to a vast multitude of patients afflicted with cancer of the stomach. Early cancer of the stomach does not give evidence of its presence *per se*, but only as it interferes mechanically with gastric function: first and most important, by obstruction, the early presence of which is fortunate for the victim, requiring, as it does, an early surgical investigation; second, by tumor.

Cancer of the body of the stomach is ushered in by a long train of indefinite symptoms, the lateness of the appearance of obstruction and tumor usually precluding the possibility of surgical cure. On the contrary, early obstruction and early tumor indicate not only a favorable condition, but that the growth is in the pyloric end, the removable part of the stomach.

It has been stated by some authority, now happily forgotten, that the presence of tumor in the stomach proved the condition to be hopeless. Quite the contrary is true. The appearance early in the disease of a movable tumor, with or without obstruction, promptly gives a diagnosis and makes surgical relief possible in a high percentage of cases. I will not insult your intelligence by calling attention to the fact that the ability to feel a tumor is not confined to the gastric specialist, and certainly the diagnosis of a mechanical obstruction is simple in the extreme. The patient is told to take a full meal in the evening, including with it some raisins and half-cooked rice. Any residue in the stomach is removed in the morning with the stomach-tube, and if food remnants are repeatedly shown, the diagnosis of mechanical obstruction is established. It is objected that some of the obstructions are due to ulcer. Quite true, but such obstructions are equally incurable by medical means.

In our series of cases cancer of the small intestine occurred thirteen times. Of these, five were of the duodenum and could not be subjected to operation beyond the exploration necessary to establish their presence; two involved the jejunum at its origin and were inoperable, and six originated in various parts of the jejunum and ileum, all of which were resected.

It is evident that the small intestine, perhaps because of its freedom from sources of chronic irritation, is not often the primary seat of cancer. In two of the patients the neoplasms began upon the polypoid growth, again illustrating the baneful influence of chronic irritation. Resection with removal of the tributary lymphatics is, of course, indicated.

Fortunately the limited caliber of the small intestines calls early attention to the growth by obstructive symptoms, while the situation in the abdomen gives an opportunity for palpation in the discovery of the tumor.

We have resected the large intestine sixty-nine times for carcinoma. Of these, twenty-eight were of the cecum and ascending colon, nine of the transverse colon and flexures, 32 of the sigmoid and descending colon. Sixty per cent. of our patients subjected to resection more than three years ago, and who recovered from the operation, are alive and well; several of them have passed the five-year period.

Cancer of the large intestine clearly illustrates the pernicious influences of which I have spoken previously. The colonic contents are mechanically more irritating than the small intestine, as the ingesta is more solid in character as well as more prolonged in residence. Fortunately cancer of the large intestine is among the most curable to which the human being is subject. It has a very limited lymphatic connection; not only are the glands sparse; but they are slow to take offense. This is rendered necessary by the very nature of its function, and even when enlarged glands are found they are often the result of the accompanying infection without actual invasion of the cancerous cells. Not only this, but its lymphatics lie in well recognized groups and are capable of surgical removal.

In conclusion I wish to call attention to cancer of the gall-bladder as an illustration of the fact that cancer is primarily a local condition, and curable by surgical operation in that stage, and again because it illustrates the perniciousness of chronic irritation of gall-stones in its production.

Of the 3,084 cases of gall-stone disease which we have operated upon, in no less than 74—nearly 3 per cent.—cancer involved the gall-bladder and biliary tract, and in every case in which we were able to ascertain the facts, gall-stones were present. In 8 cases the gall-bladder and a considerable portion of the liver were removed for a known cancer process. None of these patients lived a year, but in five instances of removal of a thickened, functionless gall-bladder containing stones, in which cancer was not suspected, the microscopic examination of the removed gall-bladder showed early cancer. All but one of these patients are alive and well.

In summing up it can be shown conclusively, I think, that there is no reason why operations for cancer of the gastro-intestinal canal should not show results as good, both immediate and remote, as operations for cancer in any other part of the body.

CARCINOMATA OF THE GALL-BLADDER AND BILIARY PASSAGES

BY WILLIAM J. MAYO

From December 5, 1890, to December 31, 1910 (Mayo Clinic, St. Mary's Hospital), 3,908 operations were performed for different causes upon the gall-bladder and biliary passages. Of this number, 85, or 2.1 per cent., of the cases were malignant. While this proportion does not make malignancy a common condition, yet it is sufficiently frequent to merit careful attention. The true proportion would be somewhat higher than these statistics indicate, as cancer of the gall-bladder, like most malignant diseases of the internal organs, is slow to be recognized, and is usually so far advanced that upon the first careful physical examination the nature of the malady is apparent and the question of necessity for operation does not arise.

Carcinoma of the Gall-bladder.—Schroeder,[1] after an investigation of the subject, says that 14 per cent. of gall-stone patients eventually suffer from cancer of the biliary apparatus. Our statistics as quoted above would not substantiate so high a percentage of malignancy.

Courvoisier[2] found that 74 out of 84 cases of malignant disease of the gall-bladder had gall-stones. Siegert[3] states that in 95 per cent. of all cases of primary cancer of the gall-bladder, gall-stones are present, and he adds the significant fact that calculi are found in only 15 per cent. of secondary malignant disease of this organ. In the London Cancer Hospital Beadle[4] found that gall-stones were present in 4 cases of primary cancer of the liver, and that in 36 cases of secondary cancer of the liver gall-stones were not detected in a single case. Musser[5] states that gall-stones occur in primary cancer of the gall-bladder in 69 per cent. of the cases, but says that in the many instances in which stones were not discovered, there were evidences that calculi had passed. In nearly all of the cases in our own series gall-stones were present. After an exhaustive examination of the subject of cancer of the gall-bladder and bile-ducts, Kelynack[6] has placed the proportion of primary cancer of the gall-bladder at 75 per cent., and the proportion of primary cancers of the bile-ducts at 25 per cent. Kelynack called attention to another noteworthy fact, namely, that cancer of the gall-bladder was at least three times more frequent in women than in men, and that this proportion is also true of gall-stone disease. Siegert found cancer of the gall-bladder in 79 females and 14 males out of the 93 cases in his series.

Cancer of the gall-bladder is more common between the ages of fifty and sixty, which is the period of the greatest frequency of gall-stones. Sutton[7] states that columnar epithelium from the mucous membrane is the type of the carcinomatous process, but in most instances it could not be determined whether its origin was in the mucous glands or the epithelium. It is to be noted that the cholesterin which forms the chief constituent of gall-stones is also a product of the mucous membrane. Butlin[8] states that the cancerous ulcer is the more common form, but Sutton has found general cancerous infiltration of the gall-bladder, forming a hard, thick-walled tumor, with a small cavity containing stones, to be the more common variety. In this latter group the majority of the cases which we have observed could be placed.

It will be noted that in the two types which compose the greater number of the reported specimens the gall-bladder not only contained stones, but the primary lesion at once suggested this probable source of irritation. Other gross forms of malignant disease of the gall-bladder are also found, particularly that type in which a tumor projects into the cystic cavity. Perforation into the peritoneal cavity rarely takes place, and when it does occur, the viscera may be found studded with cancerous growths, causing ascites, etc., or fistulous openings between the gall-bladder and the hollow viscera may occur. The more common mode of extension is to the adjacent liver, either directly or through the blood-vessels, and to the lymphatic glands lying in the hepatic fissure.

The following indisputable facts are worthy of attention: (1) Gall-stones are almost always present in primary malignant disease of the gall-bladder, and rarely present in secondary. (2) The relative proportion of gall-stone and malignant disease of the gall-bladder in women and in men is practically identical. (3) Similarity in age-frequency. (4) The pathologic lesions found are best explained on the basis of gall-stone irritation.

We are certainly warranted in concluding that gall-stones are the most important etiologic factors in malignant disease of the gall-bladder. The question assumes practical importance, and while I do not wish to say that for this reason alone gall-stones should be removed, it certainly is a factor in deciding that the early removal of gall-stones, other things being equal, is sound surgery, particularly since nearly all of the mortality-giving complications are the result of delay. Uncomplicated operation for gall-stones has a mortality of less than 1 per cent. Sherrill[9] has recently made an investigation of the subject of cancer of the gall-bladder, and his conclusions are practically identical with those of the other investigators herein quoted.

The diagnosis of primary cancer of the gall-bladder is usually not difficult. As a rule, a hard tumor may be detected in the region of the gall-bladder, which is not very tender to touch, and unless there is peritoneal involvement, rigidity of the overlying muscles is not marked. Progressive loss of flesh, and later a cachexia, will be noted. As the liver becomes involved, nodular tumors may become apparent, and in the later stages jaundice may occur from the involvement of the common and hepatic ducts. When jaundice appears in these cases, it is persistent and unchanging, and if tumor is present, and a history is obtained of loss of flesh before the appearance of the jaundice, there can be but little doubt as to the cause, especially if the jaundice was painless in development. A previous history of gall-stone disease can usually be obtained. Naunyn[10] states that at least one-half of the cases of jaundice which are diagnosticated as due to gall-stones are caused by, or are complicated with, cancer. This percentage, however, as compared with our findings, is altogether too high.

It was pointed out by Courvoisier long ago that stone in the common duct was accompanied by a contracted gall-bladder in 84 per cent. of cases, and that jaundice from this cause was, at least in the early stages, intermittent, and often accompanied by chills and fever due to an infective cholangeitis. A distended gall-bladder with jaundice will be found to have origin in malignant diseases of the bile-duct in a high percentage of cases. We have, however, on several occasions seen a cystic gall-bladder of long standing, due to stone impacted in the cystic duct, give rise to a hard nodular tumor resembling malignant disease. Occasionally such a tumor may result from a thickened gall-bladder contracted upon a mass of stones. The local tenderness and the history of sudden appearance, with the patient's good general condition, will usually be sufficient data to make a differential diagnosis. It sometimes happens that even at the operating table it is impossible to say whether a thick-walled gall-bladder is malignant or not. Robson[11] reports a case in which no fluid was found upon puncture, and the hardness of the enlarged gall-bladder, and the bad general condition of the patient, led him to the conclusion that it was malignant. Drainage was established and permanent recovery followed. Abbe[12] reports an almost identical case.

Cholecystectomy has displaced drainage in the class of cases accompanied by marked changes in the wall of the gall-bladder, and many cases of early cancer have been discovered and removed in this way with cure. Practically all unoperated cases of malignant disease of the gall-bladder die within a year.

The gall-bladder was first removed for malignant disease in the year 1887, and the number of cases reported since that time is comparatively small. Robson reported four cases some years ago, one of which died as the result of the operation. Butlin[13] reported 16 collected cases operated upon, with 12 recoveries, and of these, 9 died within four months from recurrence. In our own experience only one of a considerable number of cancers of the gall-bladder, known to be cancer at the time of operation, lived over a year, while 5 cases have lived more than two years where early cancer was removed, accidentally, so to speak, in removing a thick-walled functionless gall-bladder. In several of our cases the adjacent liver has been involved and yet the diseased process was sufficiently localized to enable resection of the infiltrated parts. So far as I have been able to learn, all of the cases in which the liver was involved secondary to primary cancer of the gall-bladder have had early recurrences.

Cancer of the Common Bile-duct.—Primary carcinoma of the common bile-duct is a rare condition. In 4,578 autopsies, Kelynack found 8 cases of primary cancer of the gall-bladder, and only 2 having origin in the ducts. Musser reports a collection of 100 cases of carcinoma of the gall-bladder and 18 of the bile-duct. The site of the neoplasm in the common duct is usually at the juncture of the hepatic and cystic ducts or near its duodenal termination. Of the 18 cases collected by Musser, 3 were in the hepatic duct and 14 in the common duct; of the latter, 9 were at or near the papillæ. In 17 cases of cancer of the ducts, Rolleston[14] found 15 in the common duct, and 10 of these were at or near the papillæ.

There is some question as to the etiology of carcinoma of the common duct. It must be conceded that gall-stones are the more common cause of cancer of the gall-bladder. In Musser's 100 cases, 69 contained gall-stones and there were evidences that calculi had at one time been present in the majority of the remaining cases. Primary cancer of the gall-bladder and gall-stone disease are more common in females than in males. This, however, is not true of duct carcinoma. Malignant disease of the common duct is equally frequent in the male and female, which does not favor the conclusion that gall-stones are the cause of the malignant process in the duct. Edes,[15] in 22 collected cases of cancer at or near the papillæ of the common duct, found gall-stones in but 4 cases, and 3 of these were in the gall-bladder. In 36 cases of cancer of the common duct Rolleston found gall-stones in less than half. Robson's extensive experience gives weight to his opinion that gall-stones are the more common cause of malignant neoplasms in the biliary passages. He believes that the calculi have not remained *in situ*, but have passed out.

The histologic variety of carcinoma of the ducts is always of the columnar-cell type, although Robson says that secondary degeneration of papillomata occurs. Systemic infection is rare; the growth usually progresses by contiguity, and sooner or later the lymph-glands in the gastrohepatic omentum and in the fissure of the liver are involved. In some of the autopsy cases reported the growth was very small, notably the case reported by Edes, in which it was not larger than a bean, even after a year or more of marked symptoms. Death usually occurs from debility, the result of the jaundice and infection of the biliary ducts. The symptoms are not distinct and diagnosis cannot often be made. The chronic jaundice and cachexia are not dissimilar to that occurring with malignant growths at the head of the pancreas, and the occurrence of glycosuria and fatty stools is not sufficiently common in pancreatic cancer to aid in differentiation. In primary carcinoma of the common duct pain is not usually severe, in this respect differing from stones in the same situation; but as so many cases have had stones at one time, the diagnostic importance of the pain symptom is not great. Usually there is no tumor present, although not infrequently the distended gall-bladder may be palpated below the margin of the liver.

The question of jaundice is an important one. In the beginning the jaundice is often intermittent in character, very like that accompanying stone in the common duct, but, as a rule, not causing infective cholangeitis. An exploration of the ducts in doubtful cases is the only way in which a positive diagnosis can be established.

McBurney[16] first called attention to the ease with which the duodenum could be opened for the purpose of removing stones impacted in the diverticulum of Vater, and he was the first surgeon to perform the operation. We have successfully opened the duodenum for this purpose in a considerable number of cases, and a large number of such operations are now on record. Incision of the duodenum for removal of stones or growths from the duodenal end of the common duct has been advocated, and instances are cited in which stones in the duct later caused carcinoma. Cancer higher up in the duct would necessitate union between the remaining fragment of the duct and the duodenum, a procedure which Halsted[17] accomplished in one of his cases and which we accomplished in a fatal case. As a palliation, cholecystenterostomy is the indicated procedure.

We have resected the common duct three times for cancer. As already stated, one patient died within twenty-four hours after operation; the second lived four months, but had biliary fistula until death; and the third, a female fifty-nine years of age, lived one and one-half years after the removal of a carcinoma of the diverticulum of Vater, which was accomplished through a duodenal incision.

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THE PATHOLOGY OF THE GALL-BLADDER AND SOME ASSOCIATED LESIONS*

A STUDY OF SPECIMENS FROM 365 CHOLECYSTECTOMIES

By WILLIAM CARPENTER MACCARTY

A study of the diseases of the gall-bladder without consideration of the closely associated organs, and without reviewing and compiling the facts regarding the embryology, anatomy, and physiology of these organs, would be not only incomplete but apt to lead us to narrow and perhaps fallacious conceptions. In text-books, journals, and lectures there is too great a tendency toward an anatomic arrangement of facts—a type of presentation which is incomplete, in that the anatomic boundaries of an organ are of no greater importance than are its functional boundaries and dependencies. Since our partial appreciation of more intimate activities of cells, and the dependency and influence of cells upon other cells, we must add to a study of every organ a consideration of its relation to other organs. Perhaps the oldest recognizable and yet unsolved dependency of organs upon other organs, or cells upon other cells, is seen in the influence upon the mammary glands by stimuli which start in the pelvis during pregnancy. There are organs, however, which are more closely related anatomically and embryologically than these, but which have not been studied correlatively. The close embryologic relation of the stomach, duodenum, bile-passages, liver, and pancreas has not been considered sufficiently from a biologic standpoint. The occurrence of such a relationship may be readily seen in the fact that phylogenetically and ontogenetically these have evolved from a single tube, the primitive alimentary canal, lined by columnar or cuboidal epithelium, which is present in the amphioxis and in the human embryo. In the simplest forms of animal life possessing an alimentary canal there is no anatomic differentiation into stomach and small and large intestine. The food-stuffs received into such a canal are broken down and assimilated through activities of the lining epithelium. In more highly specialized organisms differentiation into stomach and intestine occurs. There appears at an early stage of this evolution the original liver as a diverticulum of the alimentary tract. It develops from the duodenum; the cells multiply and become the parenchyma of the organ. The pedicle of this mass of cells retains its lumen, or develops a lumen to form the ductus communis. From this diverticulum arises another which becomes the cystic duct and gall-bladder. The pancreas and pancreatic ducts have a similar origin. It may be seen that the functional cells of the liver, gall-bladder, bile-ducts, pancreas, pancreatic ducts, and duodenum have a close common ancestry, and are therefore biologically closely related.

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One would naturally expect the life unit (that is, the cell) of multicellular organs, such as the liver and pancreas, to retain some of its original sensibilities and activities, although placed in a somewhat different environment. The same blood mechanism which bathes the tissues of the digestive tract in the simpler forms of life exists in the more specialized forms, as may be seen in the anatomic arrangement of the portal system which leads directly to the liver. At least one close physiologic instance serves to show that the pancreas, and possibly the liver, react to stimuli from the duodenum through the blood, as has been shown by Dolinsky,[1] who discovered that acids brought into contact with the mucosa of the duodenum caused prompt secretion of the pancreatic juice. Popielsky,[2] Bayliss and Starling [3] demonstrated this action after severance of the nerves which connected this organ with the pancreas, and therefore concluded that the cells of the duodenum, when in contact with a 0.4 per cent. hydrochloric acid solution, gave off something to the blood which acted on the pancreatic cells and possibly on the liver-cells.

During specialization and rearrangement of cells of the early upper abdominal alimentary canal nature has twisted the regular nerve-supply of the simplest forms until careful study now demonstrates that although the organs are distinct in the higher organisms, they are still connected by the same sympathetic, motor, and sensory nervous systems. Fibers of the splanchnic nerve reach the walls of the stomach, pylorus, bile-ducts, gall-bladder, liver, and pancreas through the celiac plexus. The vagus contains branches to and from these organs. Physiologically, a part of this nerve connection has been demonstrated by Pawlow,[4] who showed in animals that gastric secretion was increased by stimulation of the vagus. Hornborg [5] found the same thing true in the human being. Experimental stimulation of the splanchnic nerve diminishes the flow of bile, and section of the same increases the flow. Relationship between these organs may be supplemented and strengthened from the physiologic standpoint by a study of the character and distribution of portal blood. In the most simply organized animals products of the activities of the lining cells of the digestive tract are taken up by the underlying blood-capillaries and passed into the general system, and in the most highly developed vertebrates this is also true, the products, however, first passing through the liver, which was primarily a part of the digestive tract; thus the liver-cells are brought as intimately into contact with and are bathed by the same fluids as the cells out of which the liver grew in the simpler forms of organization. The change in the amount of liver secretion through the influence of absorbed products from the duodenum and through stimulation of the splanchnic nerve has led Howell [6] to say that we may believe that the quantity of bile secreted varies with the amount and composition of the blood flowing through the liver.

It may be said, therefore, before taking up pathologic conditions which arise in the gall-bladder, that the aforesaid organs are embryologically, anatomically, physiologically, and I shall endeavor to show, pathologically, to be considered a gastro-duodeno-hepatico-pancreatic physiologic system, and not functionally separated by arbitrary anatomic boundaries. The questions arising which may have some light thrown upon them by this study are:

First, what are the pathologic conditions which arise in the gall-bladder?

Second, what pathologic conditions are frequently associated with lesions in the gall-bladder?

Third, what evidence is there for common disturbance in the activity of the duodenum, stomach, liver, and bile-passages?

Fourth, what is the relationship between the condition of the stomach and conditions in the duodenum and the function of the liver, gall-bladder, and pancreas?

Fifth, is there any relationship between the frequency of pathologic conditions of the appendix and disturbances in the stomach, duodenum, liver, gall-bladder, and pancreas?

MATERIAL

The material for study in this paper has been furnished by 365 out of 657 cholecystectomies performed by C. H. and W. J. Mayo, and studies made by the writer at operation in cases in which cholecystostomy for drainage or stones was done.

As soon as the specimens were removed they were examined grossly and microscopically. They were classified into eight groups, which have been verified by examination of fixed specimens just previous to the preparation of this paper.

The normal gall-bladder (Figs. 74 and 75) presents itself at exploration as a bluish, thin-walled receptacle, the contents of which may be gradually expressed. It may be deeply embedded in the liver substance; it may be double or absent. It varies in size within wide limits.

In classifying the pathologic conditions into groups one must bear in mind that one specimen may present the characteristics of the several "types" described. This fact necessitates speaking of specimens as uncomplicated or complicated by other grades of lesions. The term uncomplicated simply means that grossly the specimen presented practically only one picture.

Group I: Cholecystitis Catarrhalis Acuta (Figs. 76 and 77).—There were 65 uncomplicated cases and 9 cases complicated by other stages. Forty-five (69 per cent.) of the uncomplicated cases were associated with gall-stones. In this group may be placed the gall-bladders which retain their general characteristics regarding size and color, both inside and outside; in other words, "normal," with the exception that the villi, congested and infiltrated with lymphocytes, are more prominent than normal. The infiltration may extend into the other layers of the wall. The condition occurs with or without stones. My attention was first drawn to this early condition by examination of a resected gall-bladder, which contained stones, but showed grossly no apparent change. Upon microscopic examination, however, the mucosa was infiltrated with lymphocytes and leukocytes. The diagnosis was sometimes made at operation by the thickened viscid bile, which seems to indicate hyperactivity of the glands of the mucosa and partial obstruction to the natural drainage. Other specimens in which

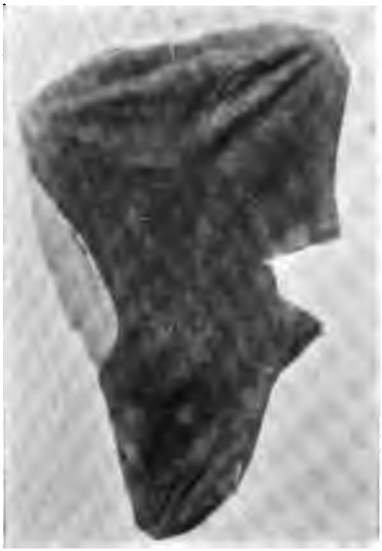


Fig. 74.—Gross specimen of a normal gall-bladder, held up to the light to show the thinness and translucency of the wall. (Case 25130.)

no stones were found presented this same condition, and clinically gave a picture of cholecystitis. The stones which occurred in these cases were usually small, and may have been passed through the ducts in the cases in which none were found, or the condition may be the forerunner of stones. This early reaction of the mucosa was seen again in association with further changes, which constitute the second group.

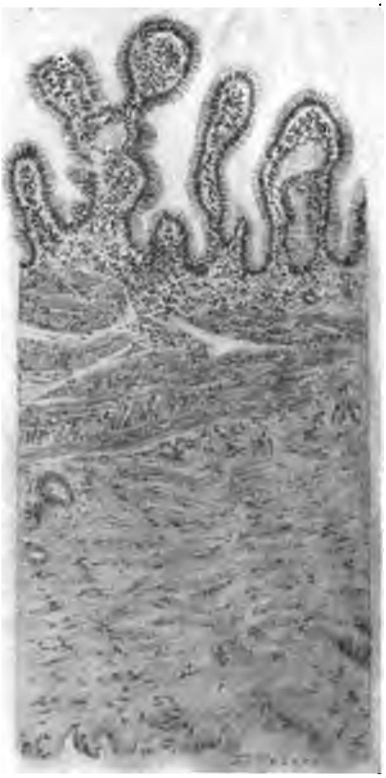
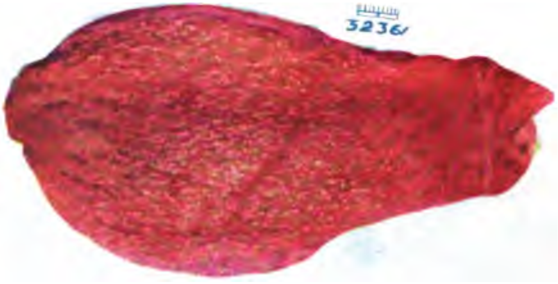


Fig. 75.—Section through the wall, showing the shape and regularity of the mucosa. (Case 25130.)

Group II: Cholecystitis Catarrhalis Chronica (Figs. 78 to 87).—Constituting this group were 39 uncomplicated cases and 39 cases associated with other types of inflammatory reaction; 30 (76 per

PLATE 5



Cholecystitis catarrhalis chronica. A color photograph showing the fresh appearance of the "strawberry" gall-bladder. (Case 32361.)

cent.) of the uncomplicated cases contained stones. These specimens vary from Group I only in degree, and one portion of the gall-bladder may belong to the first group and another portion to this group. The principal change grossly consists in an "erosion" of the apices of the villi. These desquamated apices present themselves as yellow specks scattered over the mucosa (see Plate 5). Otherwise the mucosa may appear normal or congested. This condition we have described as the "strawberry" gall-bladder on account of the resemblance of the yellow specks to strawberry seeds. These have also been mistaken for fine stones. Microscopically, one sees that the epithelium is lost and replaced by scar tissue. Clinically, there is nothing to distinguish this group from Group I. It is found with or without stones.

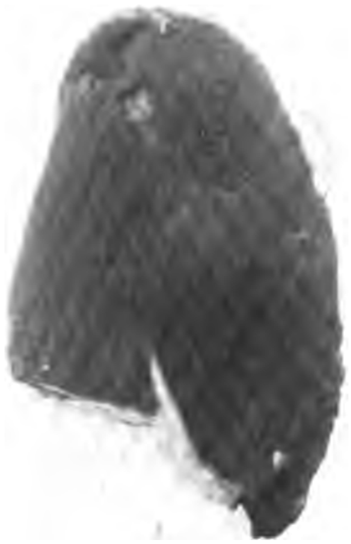


Fig. 76.—Cholecystitis catarrhalis acuta, in which the translucency has disappeared on account of the congestion and swelling of the mucosa. (Case 23219.)

Group III: Cholecystitis Catarrhalis Papillomatosa (Figs. 88 to 90).—In this group there was only one specimen. One of the villi was enlarged and appeared as a papilloma. The condition was associated with stones and an acute catarrhal reaction in the mucosa. The papilloma was 2 mm. long and about 1 mm. in diameter (Fig. 88, *a*). The cells of the epithelium covering the villi and papilloma were regular in size and shape and possessed nuclei showing no irregularities.

Group IV: Cholecystitis Papillomatosa Malignum.—Like papillomata in other portions of the body, these often undergo an irregular or perverted hyperplasia, which manifests itself in marked reduplication of the rows of epithelial cells. Upon high-power examination of the epithelial cells the chromatin granules are irregularly distributed; the nuclei are irregular in shape and size. These cells may or may not dip below the basement membrane. Such cases have been found during exploration, at which time portions of the gall-bladder were taken for examination. This type does not occur in this series because the cases seen were studied at exploration of inoperable cases.

Group V: Cholecystitis Catarrhalis Carcinomatosa (Figs. 91 to 100).—There were three cases of cholecystitis catarrhalis chronica which were complicated by carcinoma. The hypertrophy in the least advanced portions of the changed mucosa appears as knob-like outgrowths covered by epithelium which is in a stage of hyperplasia, which differs apparently from simple hyperplasia morphologically in that the nuclei are large, irregular in shape and size, and have irregularly distributed chromatin (Figs. 94, 95, 96). There are areas, however, which contain glands, the nuclei of which are regular and indistinguishable from normal or hyperplastic glands (Fig. 99). The more extensive outgrowths (Fig. 91, *b*) arise from the mucosa and possess a base not unlike that seen in the papilloma (Fig. 89). The body of the growth is composed of masses of epithelium (Figs. 92, 93) which, upon high-power examination, presents extensive irregularities in the size, shape, and distribution of the chromatin granules. Differentiation between this group and Group IV, cholecystitis papillomatosa malignum, must be made with reserve, because it is possible that the one is but a stage of the other. No specimens in my series presented sufficient evidence

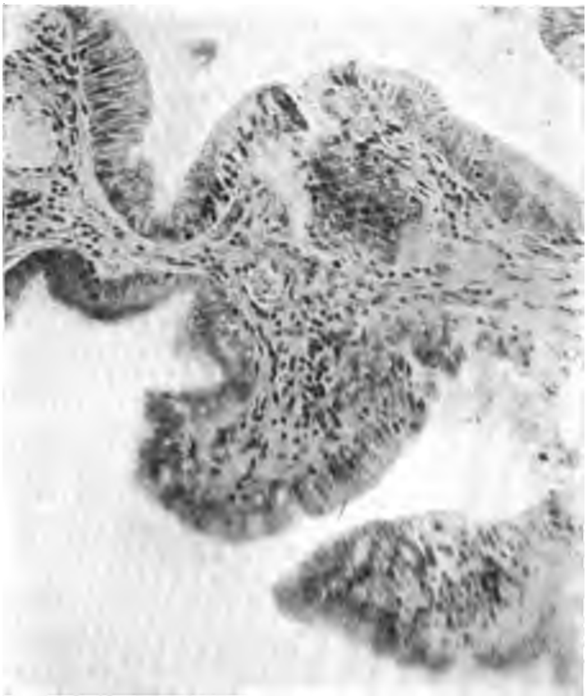


Fig. 77.—Cholecystitis catarrhalis acuta. A section showing the hyperplasia of the epithelium and infiltration of the villi. (Case 23219.)

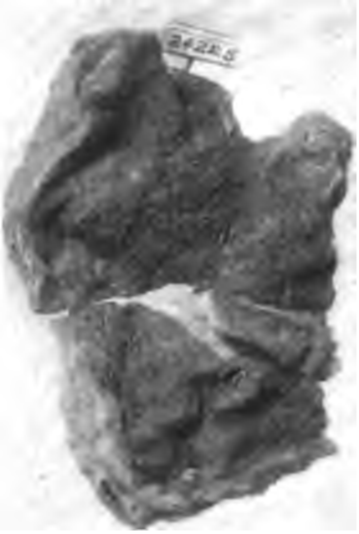


Fig. 78.—Cholecystitis catarrhalis chronica. The apices of the villi are eroded, leaving points of white or bile-stained connective tissue which cause the "strawberry" appearance against the velvety background. (Case 24225.)

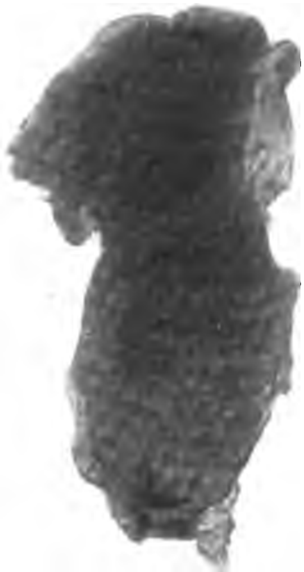


Fig. 79.—Cholecystitis catarrhalis chronica. (Case 17852.

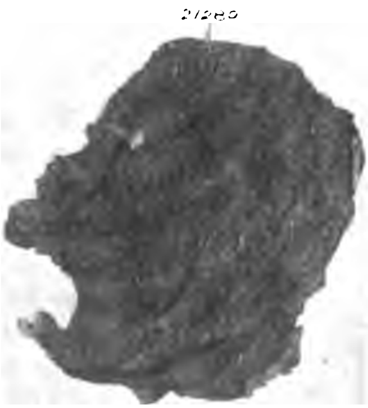


Fig. 80.—Cholecystitis catarrhalis chronica. (Case 21280.)

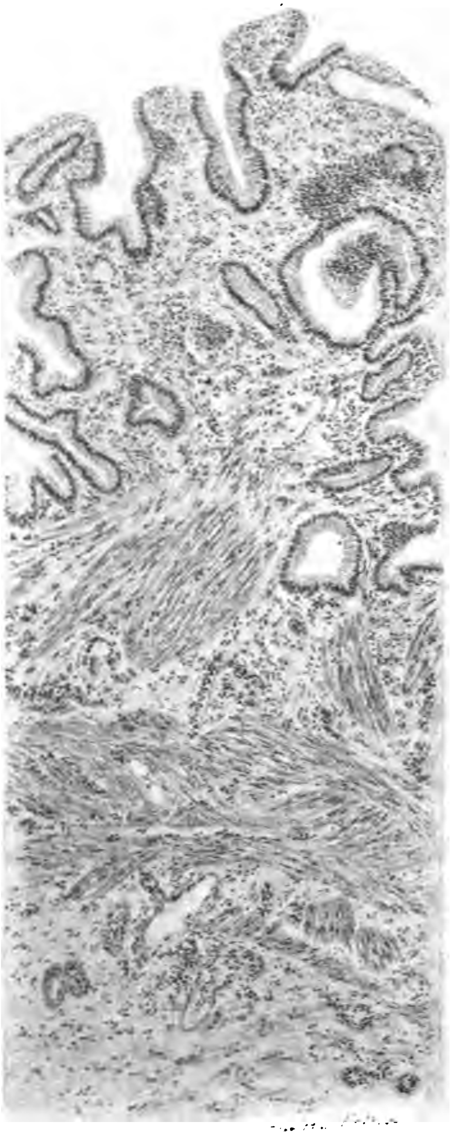


Fig. 81.—Cholecystitis catarrhalis chronica. Section through the thickened wall and desquamated apices. (Case 24225.)

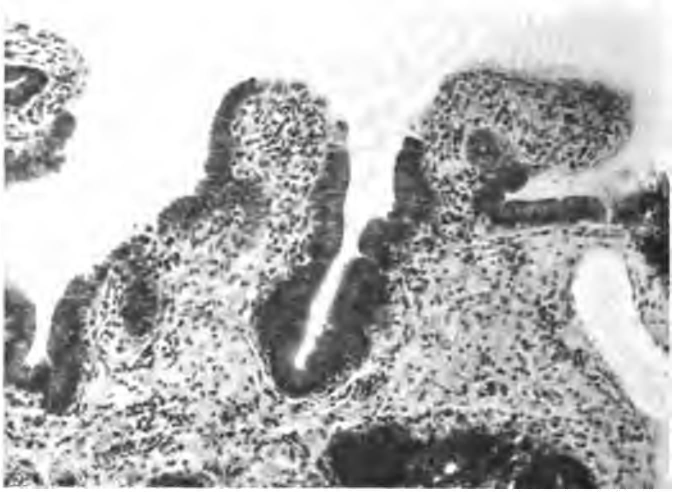


Fig. 82.—Cholecystitis catarrhalis chronica. (Microphotograph of Case 24225.

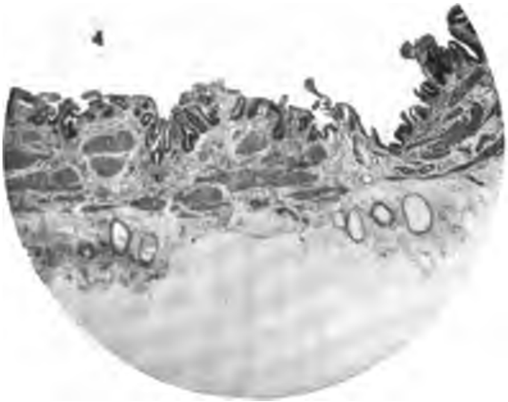


Fig. 83.—Microphotograph showing the distortion and irregularity of the mucosa. (Case 24225.)

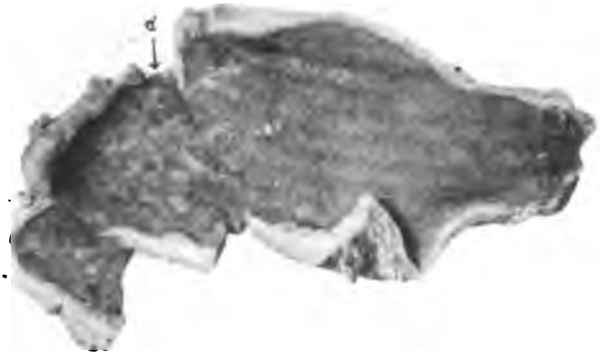


Fig. 84.—Cholecystitis purulenta necrotica. (*a*) Abscesses. (Case 19698.)

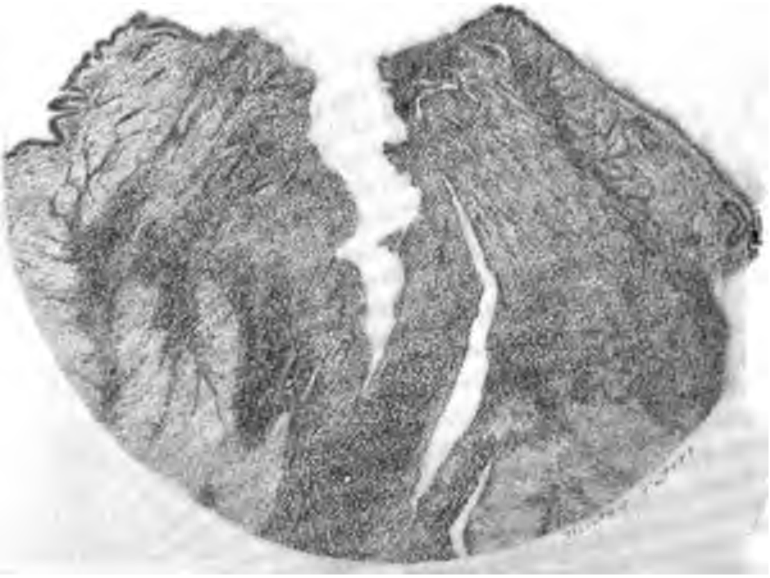


Fig. 85.—Section through an abscess in the mucosa. (Case 19698.)

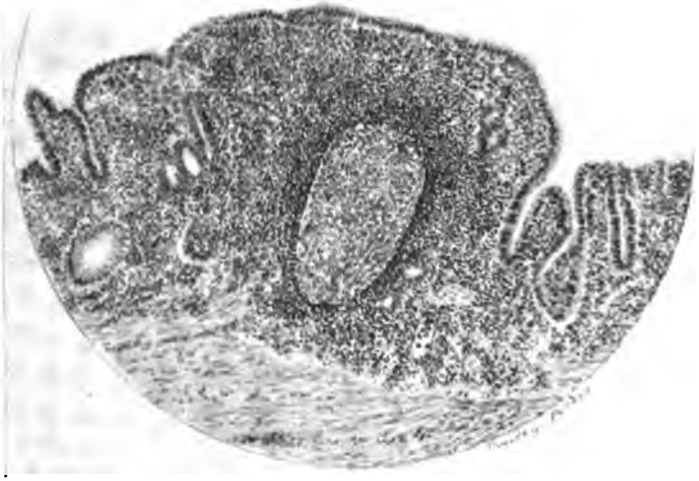


Fig. 86.—Cholecystitis catarrhalis acuta. Section showing the infiltration of the mucosa and proliferation in a lymph-follicle. (Case 20601.)

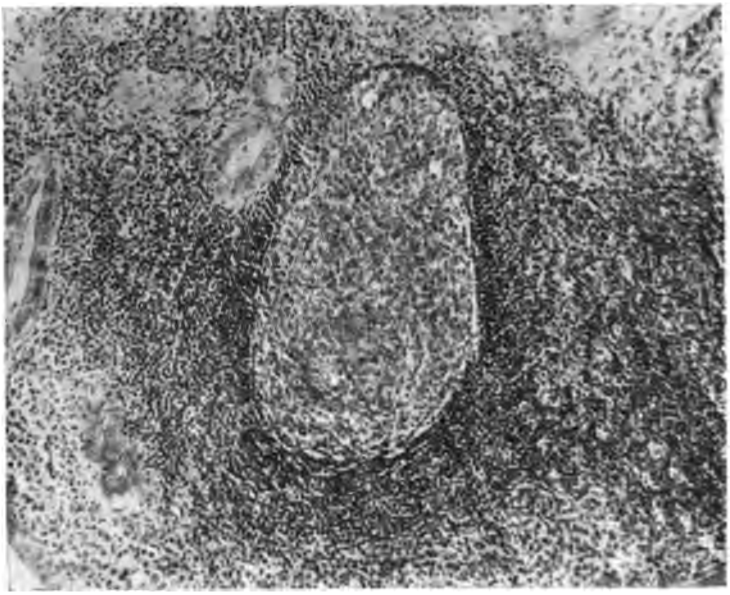


Fig. 87.—Microphotograph. The germ center (Fig. 86). (Case 20601.)

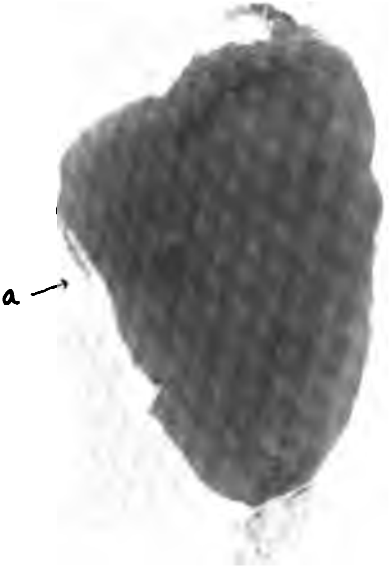


Fig. 88.—Cholecystitis catarrhalis acuta. Showing a papilloma (*a*). (Case 30267.)

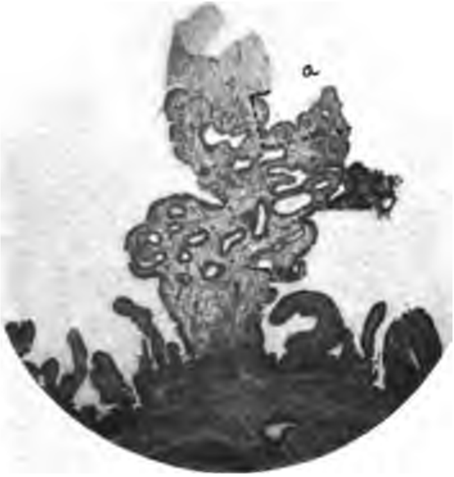


Fig. 89.—Microphotograph of a section through the papilloma (Fig. 88). (Case 30267.)

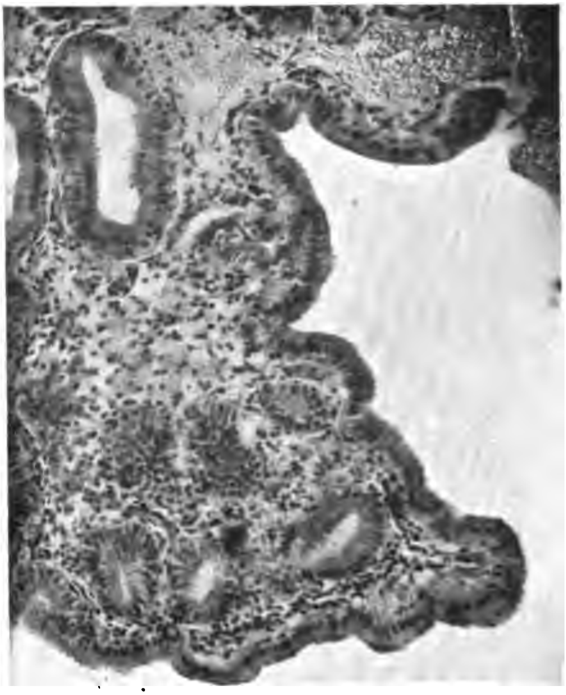


Fig. 90.—Microphotograph of a section through Fig. 89 *a*. (Case 30267.)

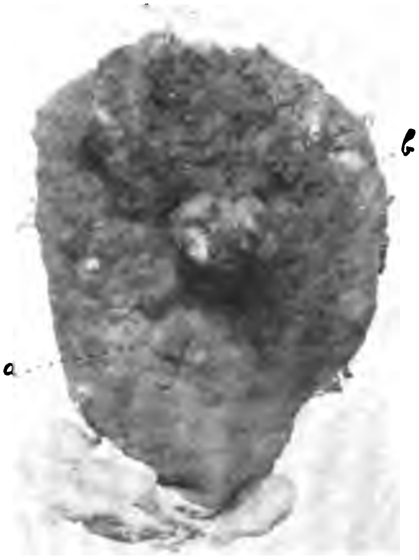


Fig. 91.—Cholecystitis catarrhalis carcinomatosum. (Case 30188.)

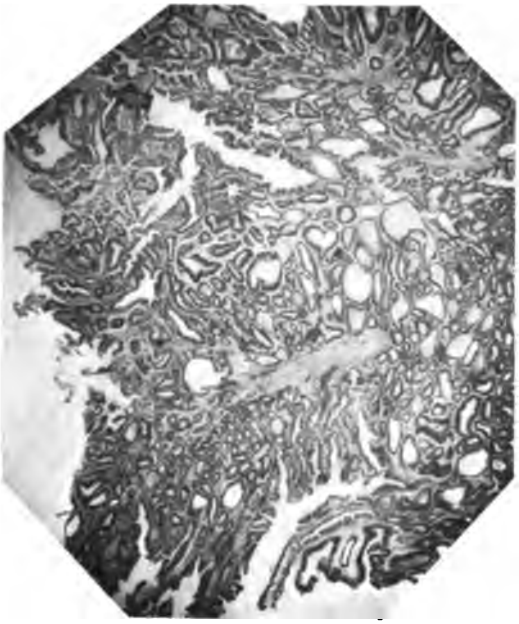


Fig. 92.—Microphotograph of a section through the pedicle of portion *b*, Fig. 91. (Case 30188.

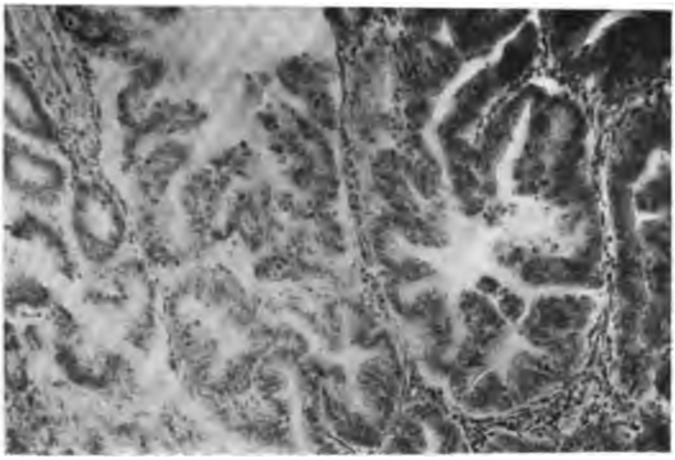


Fig. 93.—High-power microphotograph of Fig. 92. (Case 30188.)

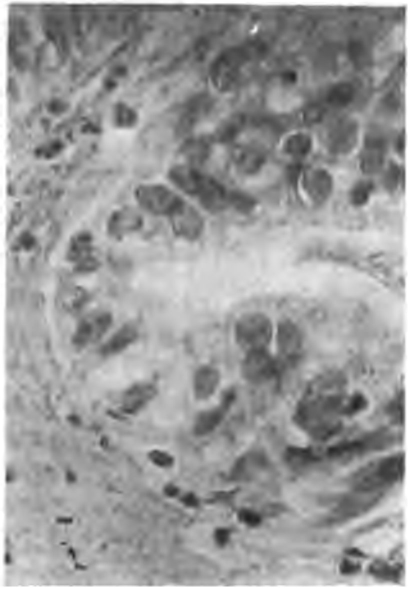


Fig. 94.

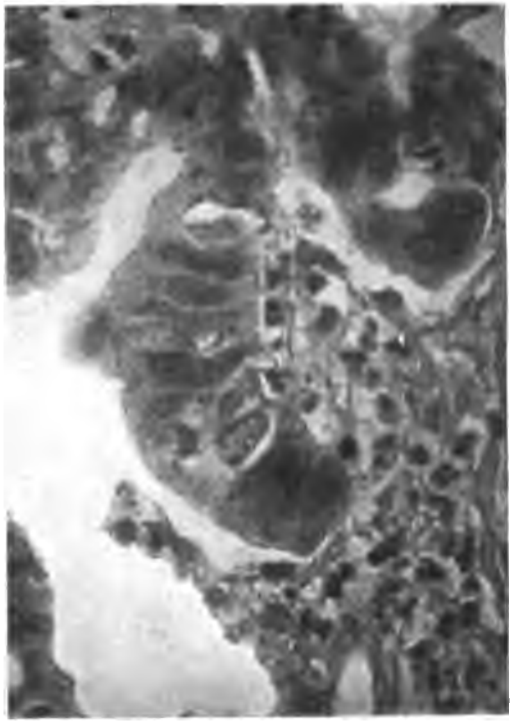


Fig. 95.

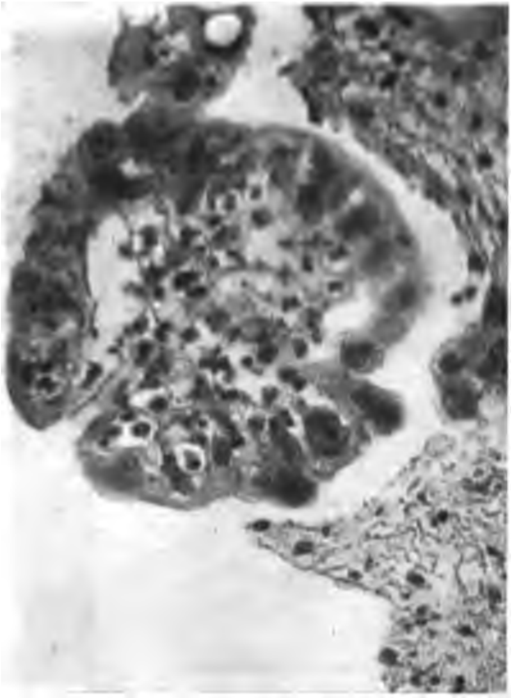


Fig. 96.

Figs. 94, 95, and 96. - Microphotographs showing the irregularity of the cells in portion *b*, Fig. 91. (Case 30188.)

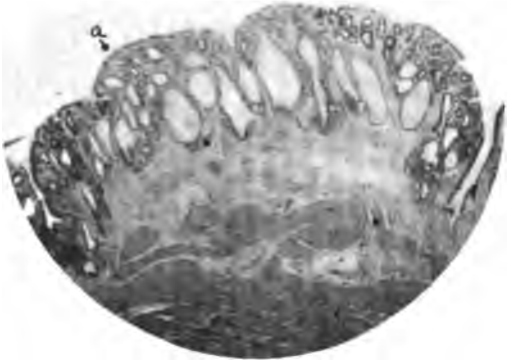


Fig. 97.—Microphotograph of a section through portion *a*, Fig. 91. (Case 30188.)

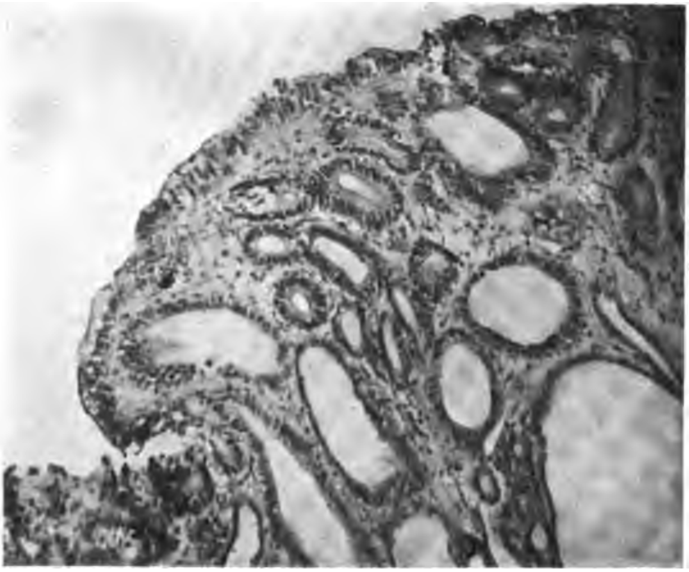


Fig. 98.—Microphotograph of a section through portion *a*, Fig. 97. (Case 30188.)

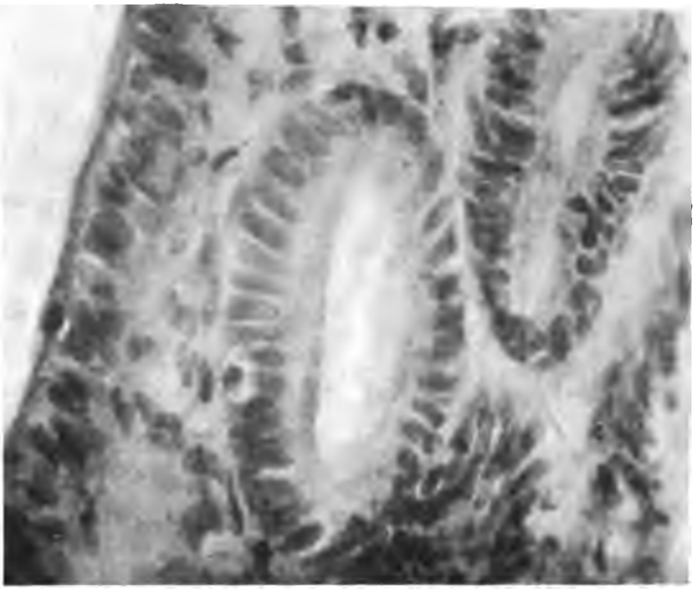


Fig. 99.—Microphotograph showing the regularity and irregularity of the cells in Fig. 97. (Case 30188.)

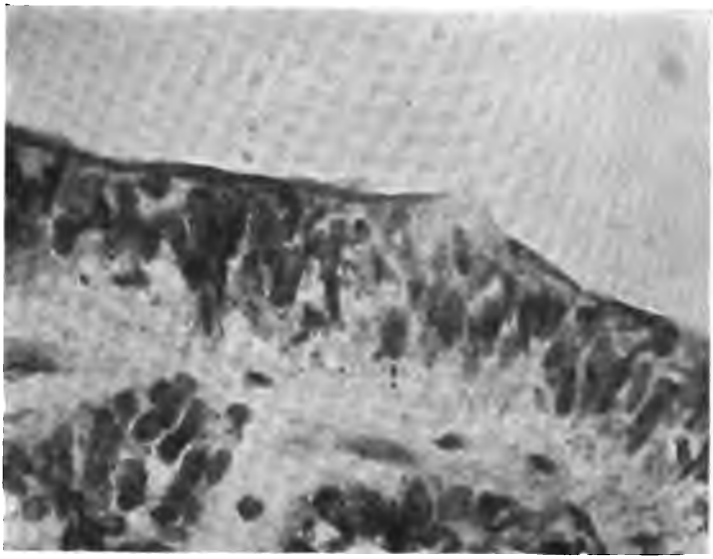


Fig. 100.—Microphotograph of the lining epithelium. (Case 30188.)

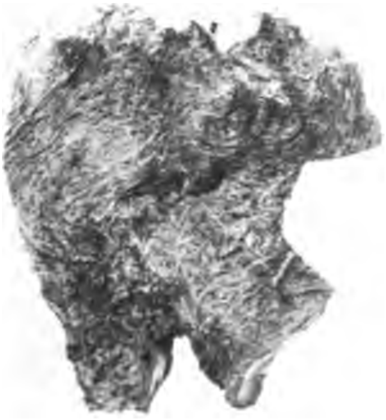


Fig. 101.—Cholecystitis chronica. (Case 25208.)

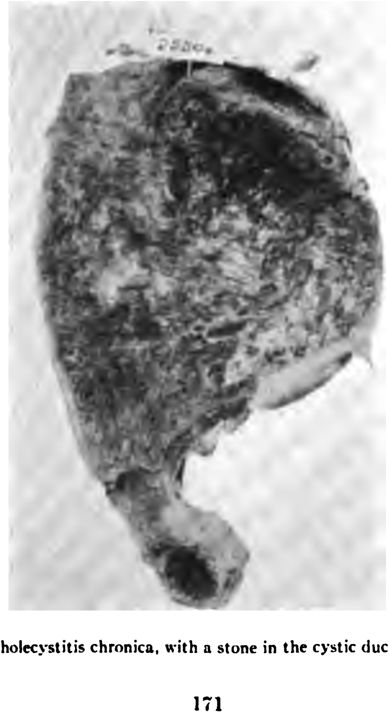


Fig. 102.—Cholecystitis chronica, with a stone in the cystic duct. (Case 25504.)

18407

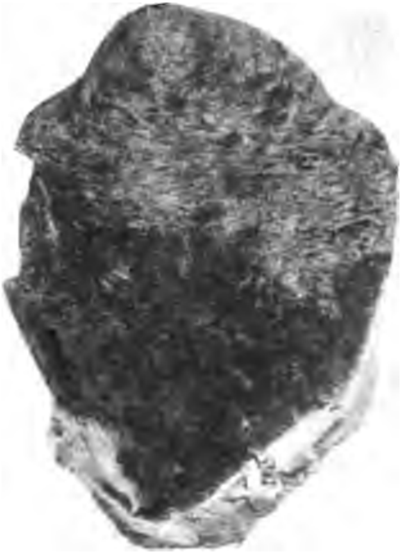


Fig. 103.—Cholecystitis chronica with almost complete destruction of the mucosa: *a*, Patches o intact mucosa; *b*, scar tissue ridges. (Case 18407.)

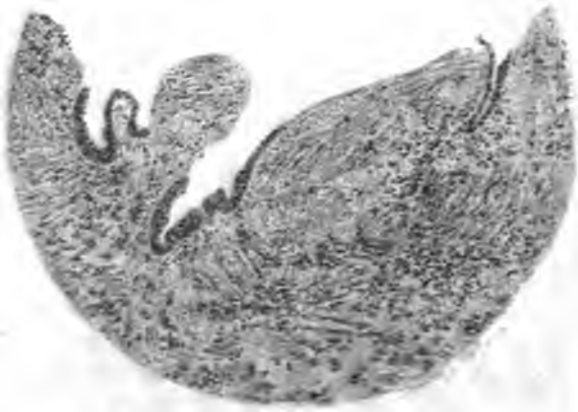


Fig. 104.—Section through the incompletely destroyed mucosa. (Case 18407.)

for grouping both conditions under one heading. They present papillomatous outgrowths, differing only in shape. Those under Group VI were knobs, while those in Group IV were filiform and less massive. Earlier stages of carcinoma of the gall-bladder must be found and studied before the life-history of such perversions of the epithelium can be accurately pictured.

Group VI: Cholecystitis Chronica (Figs. 101 to 108).—There were 78 uncomplicated and 64 complicated cases; of the uncomplicated 73 (93 per cent.) were associated with stones. In this group is placed a condition, gradual stages of which may be seen in specimens of Group II. The continued desquamation of the apices of the villi is associated with proliferation of the connective tissue of the villi and submucosa. The surface, which is normally regular, contracts irregularly and leaves ridges of scar tissue. Upon microscopic examination the inner surface is seen to be void of epithelium and the mucosa has been replaced by scar tissue. The process is

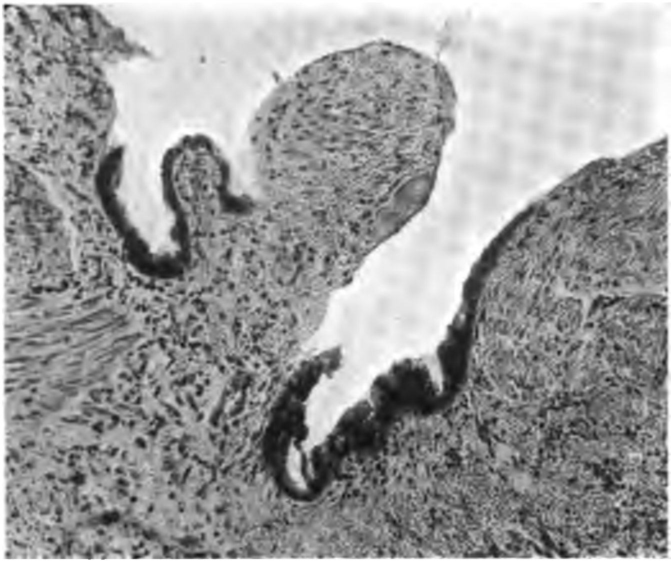


Fig. 105.—Microphotograph of Fig. 104.

not always complete over the whole gall-bladder, as a result of which areas of the condition described in Groups I and II may be seen (Fig. 103). It may occur at operation with or without stones. It has been classified under the term cholecystitis chronica because the mucosa has almost completely disappeared and the process is a chronic one involving the other coats of the wall.

Group VII: Cholecystitis Chronica Cystica (Figs. 109, 110, 111, 115, 116, 117).—Seventy-six cases. A stone may become lodged in the cystic duct or in the valves of the neck of the gall-bladder and cause obstruction and distention of the organ. This results in thinning of the wall and destruction of the mucosa or flattening of the scar tissue ridges in the chronic cases. The stone usually is firmly embedded between the valves and cannot be moved in either direc-

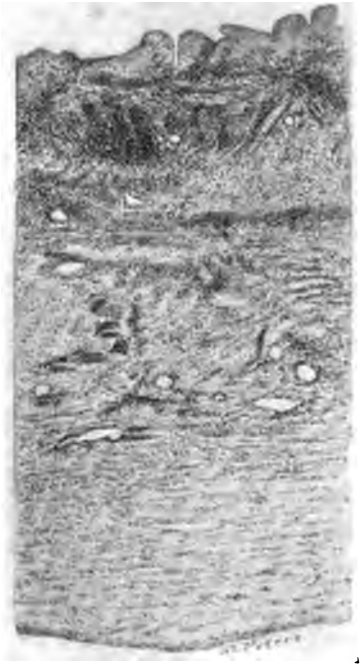


Fig. 106.—Section through the wall, showing the complete loss of mucosa. (Case 18407.)

tion. Microscopically the wall is a thin layer of connective tissue in which traces of the nuclei of muscle-cells may be seen sometimes. Such a gall-bladder attains great size, and is usually the type which presents itself as a large palpable tumor.

Group VIII: Cholecystitis Purulenta Necrotica (Figs. 84, 85).—Thirty-three cases. During any stage of inflammation obstruction to the cystic duct may be so great, or the pyogenetic infection so virulent, that disturbance of the circulation or multiple abscesses in the gall-bladder may occur. The specimens are usually distended, dark blue or black, the contents pus or blood and usually not bile-stained.

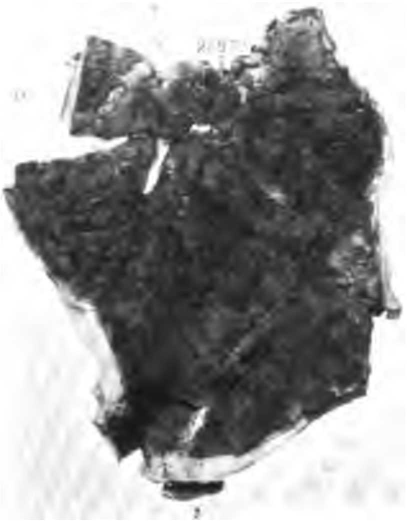


Fig. 107.—Cholecystitis chronica. (Case 26870.)

Pericholecystitis acuta and chronica must be considered a sequel of any of the above mentioned degrees of inflammation. Even in the earliest degree of cholecystitis catarrhalis acuta the process may extend to the serosa through the lymphatics, and it is not infrequent to see adhesions, usually to the omentum and transverse colon, in this stage.

RÉSUMÉ OF THE GROUPS

It may be seen that the pathology of the gall-bladder reduces itself not to definite pathologic lesions, but to stages in a pathologic process, which consists of an infection of the mucosa of the gall-bladder, the common or cystic ducts. The elements of disturbance are mechanical and inflammatory. Disregarding the etiology

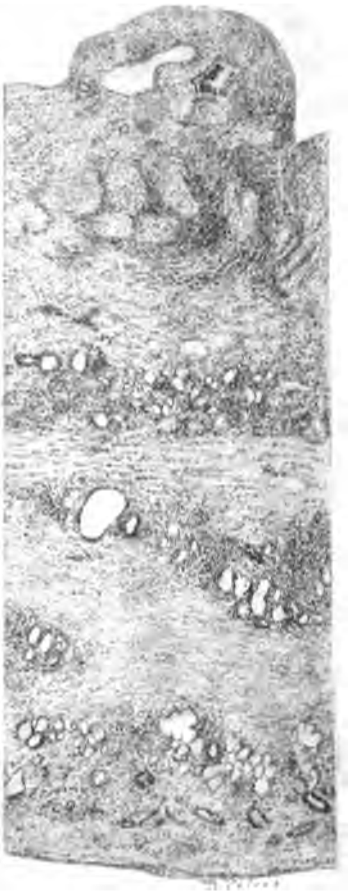


Fig. 108.—Section through the wall. (Case 26870.)

of the condition and whether the infection ascends from the duodenum or descends from the liver, the fact remains that swelling of

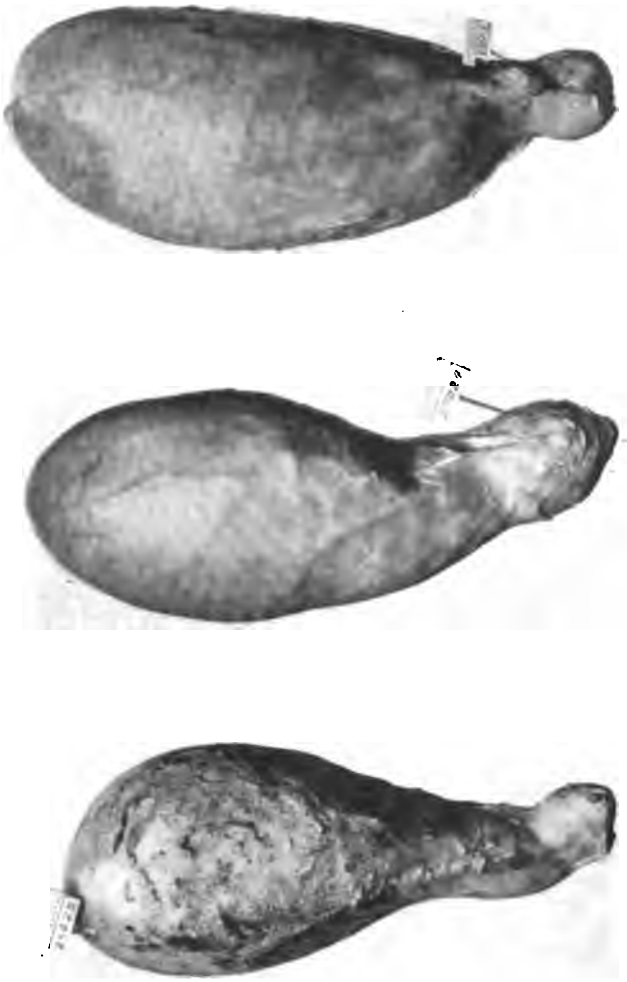


Fig. 109. Fig. 110. Fig. 111.

Figs. 109, 110, and 111.—Cholecystitis chronica cystica with a stone in the cystic duct. (Cases 27024, 28912, 23428.)

the mucosa in the ducts at any point in the presence of and aided by some infecting organism causes certain changes or reactions

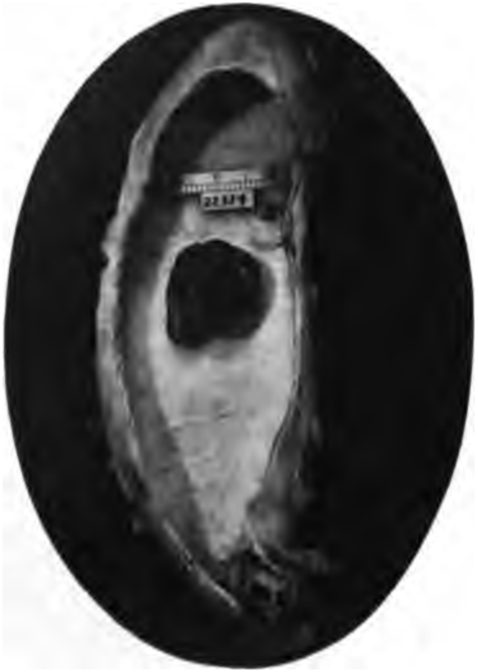


Fig. 112.

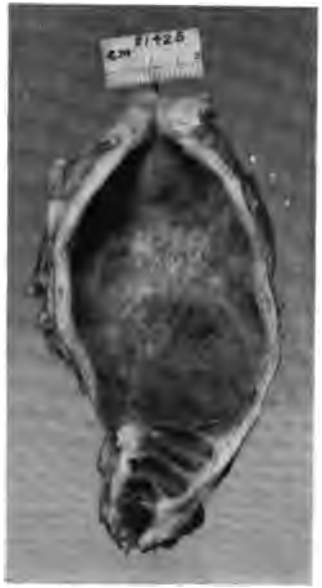


Fig. 113.

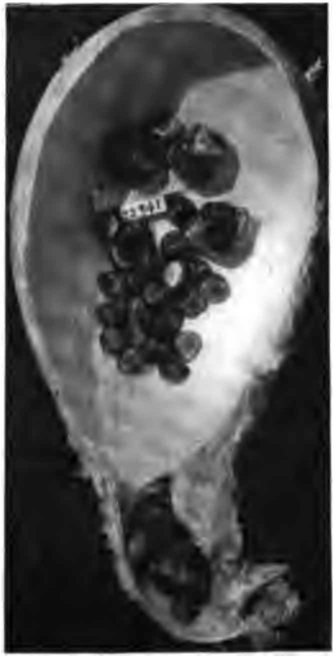


Fig. 114.

Figs. 112, 113, and 114.—Cholecystitis chronica with a stone in the cystic duct. (Cases 22334, 21425, 22341.)

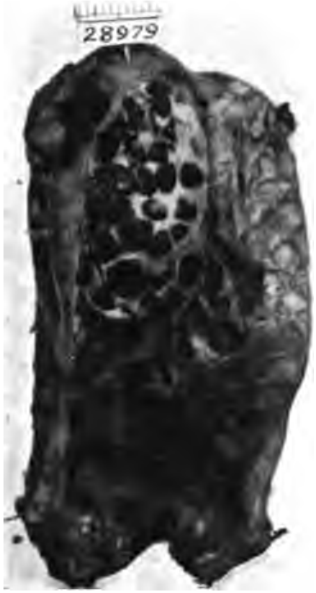


Fig. 115.

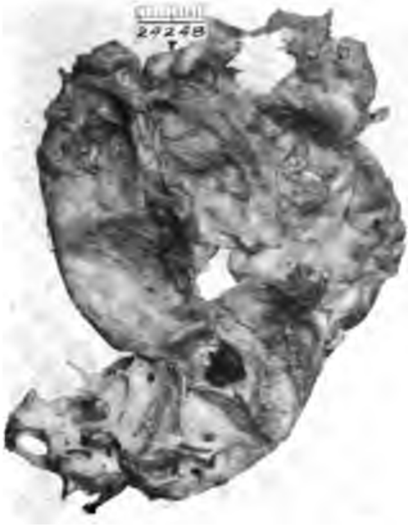


Fig. 116.

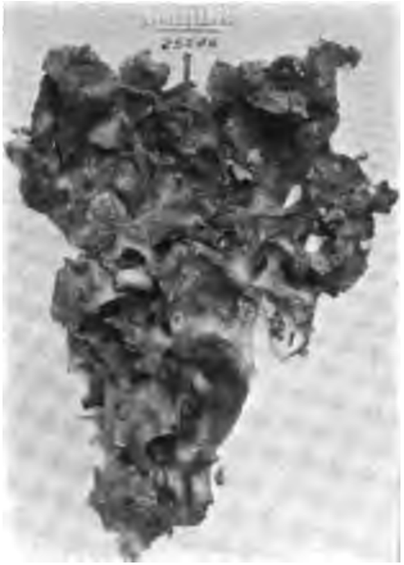


Fig. 117.

Figs. 115, 116, and 117.—Cholecystitis chronica with stones embedded in the wall, which gives the specimens the name "honeycomb gall-bladder." (Cases 28979, 22546, 24248.)

in the wall of the gall-bladder. The reaction is not unlike inflammation in other parts of the body. To a mild obstruction or infection the first reaction is congestion of the mucosa with slight infiltration. Grossly, the mucosa does not differ perceptibly from the normal mucosa. At this stage the bile at exploration may be of great assistance in making the diagnosis: it may contain an increased amount of "mucin," which gives it greater cohesive quality. Adhesions to the gall-bladder do occur, even with this slight degree of reaction. Congestion and necrosis of the mucosa result in desquamation of the epithelium, thus leaving the tips of the villi bare. These become bile-stained and appear as yellow specks, thereby causing the "strawberry" appearance. This condition is only a stage toward further destruction of the epithelium, flattening of the villi, and increase in density, due to connective-tissue proliferation, until the velvety appearance of the inside of the gall-bladder disappears and is replaced by a gray, not infrequently pigmented surface. Externally the wall is seen to be gray and dense. Microscopically, the degrees of the process may be verified.

An obstruction to the outflow of the contents of the organ by a stone in the duct plus a pyogenetic infection disturbs the circulation of the wall, causes pus formation and necrosis, which may bring about rupture of the wall and peritonitis, or drainage into neighboring organs. The fact that this complication may occur in gall-bladders in any of the above-mentioned stages results in different pictures of the conditions. The mucosa may be partially intact or completely destroyed. Blocking of the cystic duct alone does not always produce necrosis; at least specimens at operation are often seen in which there is complete obstruction, due to an impacted stone, and which present themselves as large, distended, gray-colored, thin-walled cysts. The contents are almost always clear or slightly cloudy and free from bile-pigment. The inner surface is usually smooth, or shows only traces of the scar tissue ridges described under cholecystitis chronica.

The relation between inflammation and carcinoma has been so constant in many parts of the body, especially demonstrated in the stomach by Oettinger,[7] Hoche,[8] Graham,[9] Wilson and MacCarty,[10] MacCarty,[11] *et al.*, who have shown that a very high percentage of stomach carcinomata occur in the walls of chronic ulcers, that one strongly suspects in the nine cases* of carcinoma of the gall-bladder in which the average duration of symptoms was nineteen and four-tenths years, that the malignant perversion did not exist over such a long period. This is especially reasonable when one considers that in 280 cases, which were not carcinoma and in which the duration was stated in the histories, the average was only six and seven-tenths years.

The question to be asked after a survey of these figures is, Can carcinoma exist nineteen and four-tenths years and give symptoms, or were the symptoms inflammatory during this period?

CONTENTS OF THE GALL-BLADDER

From a diagnostic standpoint during operation the fluid contents of the gall-bladder may give much information to the operator.

The bile, which normally is a thin amber-colored fluid containing a small amount of mucus, reveals grossly not infrequently the stages of infection.

An excess of mucus which causes it to be "stringy" is a result of an abnormal activity of the glands of the mucosa, and is almost invariably, if not always, the result of infection or irritation, occurring with partial obstruction to the natural drainage. Cholesterin crystals, which may sometimes be seen grossly in bile which contains no stones, may be taken as indicative of stagnation. Very dark, dirty bile is the result of acute or chronic congestion.

In cases in which there is complete acute obstruction the bile may be bloody or purulent.

The more chronic complete obstructive cases almost invariably contain thin watery or milky fluid.

Stones (Fig. 118).—Two hundred and fifty-two, or 67 per cent., of the 365 cases were associated with gall-stones, which varied in shape, size, and composition, all of which properties bore no apparent relation to the character of the lesion in the gall-bladder.

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* There were 14 specimens of carcinoma examined, 3 were complete gall-bladders and 11 were portions removed for fresh diagnosis in inoperable cases. In only 9 of these cases was the duration stated in the histories.

Interesting, however, is the fact that the percentage of specimens in each group which were uncomplicated by other stages of inflammation and which were associated with stones increased proportionately with the extent of the inflammatory reaction in the gall-bladder; thus 69 per cent. of the specimens which were in an acute catarrhal condition contained gall-stones at operation, although in such cases the possibility of the stones having been passed must be considered.

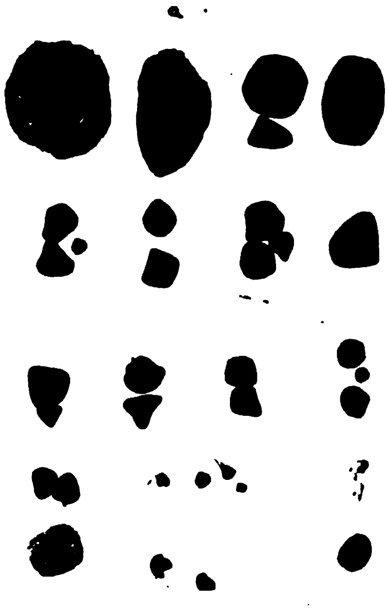

Fig. 118.—Various sizes and shapes of stones found in the series. a. A stone which caused intestinal obstruction by ulceration through the gall-bladder wall into the intestine.

Of the chronic catarrhal gall-bladders 76 per cent. were associated with stones.

In the more advanced cases of chronic inflammation, in the cases in which practically all of the mucosa was destroyed, the percentage was 93.

From these figures it would seem that the occurrence of gallstones bore a marked relation to the extent of the lesion, and that the early acute catarrhal conditions do not necessarily occur associated with stones.

CLINICAL SUMMARY OF CASES

The histories of these cases were taken by different members of the staff, and the personal equation must be taken into consideration in reviewing the clinical figures.

Age.—The youngest patient in this series was a girl (Case 21, 610) sixteen years of age, who had suffered attacks of pain under the right costal margin for one and one-half years. This was associated with jaundice and marked tenderness over the right hypochondrium. The gall-bladder was edematous, distended, and contained a stone in the cystic duct. The mucosa was intact, except the apices of the villi, the epithelium of some of which was desquamated. The specimen was classed in the groups cholecystitis catarrhalis chronica, and cholecystitis chronica cystica. The eldest patient in the series was a male (Case 25,217) aged seventy years, who, twenty-five years before operation, had suffered attacks of epigastric pain which radiated to the back. At operation the gall-bladder was filled with stones, and the thickened wall was infiltrated by carcinoma. There was a stone in the cystic duct. This specimen may be grouped as cholecystitis catarrhalis carcinomatosa. Only 25 cases, or 6 per cent., in the series were under twenty-five years of age.

Sex.—Out of 365 specimens examined 298, or 81 per cent., were from females, and 67, or 19 per cent., were from males, which emphasizes the already recognized predominance of the condition in females.

Onset of Symptoms.—It was interesting from a pathologic and clinical standpoint to determine how many cases had symptoms in early life, that is, under twenty-five years of age. It was thought that there might be some relationship between appendicitis, which is perhaps more common in this period, and the production of inflammation in the gall-bladder, as was suggested by Ochsner,[12] who thought that the portal of entry for the infecting organism might be the appendix. In the whole series there were only 83 cases with symptoms which began at or under twenty-five years of age. This may be important in distinguishing between the effect of acute and chronic appendicitis on the condition; that is to say, if the appendix plays a rôle in the etiology of cholecystitis, it is strange that such a small number of the cases began under twenty-five years of age. This fact is significant when compared with the percentage of chronically affected appendices associated with cholecystitis. The question arises whether or not the appendix is the portal of entry for the organism, or whether or not stagnation in the stomach and disarrangement of the duodenum, liver, and gall-bladder is brought about more commonly reflexly by chronic or subacute lesions in the appendix.

Pain.—Pain in cholecystitis seems to vary from mere discomfort to great severity. Practically all of the cases suffered from epigastric pain. Localized pain in the right hypochondrium and under the costal margin occurred in the majority of cases. It was referred to the shoulder in 142 cases. The characteristics of the pain were described as colics, cramps, or spasms. The attacks lasted from one to several hours, and were followed by tenderness in the epigastrium or right hypochondrium for two or three days.

Vomiting.—Two hundred and ten cases, or 57 per cent. of the series, gave a history of vomiting, although many others suffered from nausea.

Attacks.—Attacks of pain usually came on at intervals varying from twenty-four hours to months.

Jaundice.—One hundred and sixteen cases gave a history of jaundice, or were jaundiced at the time of examination. The presence of jaundice as a diagnostic sign is very important, but its absence is by no means against cholecystitis.

Constipation.—Ninety-one cases gave a history of chronic constipation.

Relation to Pregnancy.—Although many of the histories taken in married women did not record any special relation to pregnancy, there seemed to be a great many in whom the symptoms occurred during pregnancy, especially toward the end or shortly after.

Dyspepsia.—The question of a dyspepsia history previous to the onset of definite gall-bladder symptoms, which occurred in 27 per cent. of the cases, and might have occurred in more had this point been gone into more thoroughly in the taking of the history, allows of speculation, about which at present we are unable to speak positively in a study of the cases presented.

Appendix History.—Thirteen per cent. of the histories contained definite reference to pain or soreness in the appendix area.

Fever and Chills.—While these were common in many cases, it was not noted in the history often enough to be of any value, so far as a percentage was concerned.

Mortality.—Since the beginning of the hospital records there have been 657 cholecystectomies and 17 deaths, a percentage of two and a quarter.

Etiology

The etiology of cholecystitis possesses many phases about which we know nothing definite. I shall only attempt to correlate some of the results of other investigations and my own observations in studying the material obtained at operation and postoperative postmortems.

The nature of the infection in the bile-passages has been fairly well settled, although more extensive studies would doubtless throw considerably more light upon the subject.

It is fair at present, in view of the work already done on the bacteriology of the condition, to simply state that it must be considered that bacteria play an enormous rôle in the pathologic lesions seen in the gall-bladder, liver, and bile-passages. How these bacteria reach the bile and gall-bladder is still a disputed point, and may resolve itself into at least three methods, namely, indirectly through the liver from the portal circulation, as has been emphasized by Adami,[13] through the lymphatics of the intestine, or directly by an ascending infection from the duodenum through the common duct. Evidence may be given in favor of all of these methods of infection, although this paper will only deal with conditions which may favor an ascending infection, or make clearer the causes of descending infections. The points worthy of mention are the occurrence of duodenal ulcer in association with cholecystitis, the occasional presence of a duodenal ulcer at the papilla of Vater, and the association of a high percentage of chronic appendicitis with cholecystitis. The first two of these may be seen in two cases in the series herewith presented.

The first case, No. 27,238, was a male aged sixty years, who was operated upon for cholecystitis seventeen months before the last operation. He was improved for five or six months, and again had epigastric pain, jaundice, and vomiting. At the second operation, which was performed at St. Mary's Hospital, the gall-bladder was distended, the common duct dilated, and the head of the pancreas very hard. A note at operation stated that if a third operation should be necessary it should be a cholecystenterostomy. The patient died on the twelfth day after operation. The postmortem examination revealed a marked cirrhosis of the liver, chronic cholecystitis, chronic pancreatitis, chronic congestion of the spleen, and a chronic ulcer of the duodenum at the papilla of Vater about 1 cm. in diameter. There was almost complete stenosis of the common duct in the base of the ulcer.

The second case, No. 31,049, was a male, aged fifty-eight, who, four years before examination, had attacks of severe epigastric pain which radiated to the back. Seven weeks before the last operation he had similar attacks accompanied by vomiting. At operation the gall-bladder was drained for cholecystitis with one stone, and a hard mass was felt at the end of the common duct, which was thought to be carcinoma of the head of the pancreas. On the fourth day after the operation the patient died from a hemorrhage into the bowel, associated with tarry stools and hematemesis. At autopsy a duodenal ulcer 2 cm. in diameter was found. The lumen of the common duct extended apparently unobstructed through the base of the ulcer (Fig. 119).

Both of these cases, following upon the experimental work of Maffucci,[14] Charcot and Gombault,[15] Meyer,[16] and Tsunoda,[17] in which chronic changes in the liver (cirrhosis) were induced by artificial stenosis or partial stenosis of the common duct, must lead us to believe that changes at the papilla of Vater do either allow an infection to ascend the ducts, or through mechanical disturbances in the liver or gall-bladder cause a failure of these organs to prevent or resist infection of the bile from organisms in the portal or general circulation.

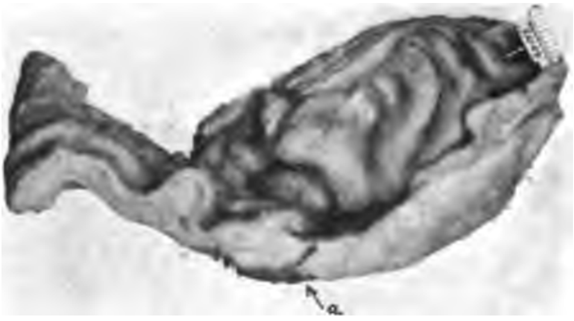

Fig. 119.—Ulcer of the duodenum at the papilla of Vater. *a*, The common duct penetrating the base of the ulcer. (Case 31049.)

The third point, the high percentage of chronic lesions in the appendix in cholecystitis cases, in which both organs were removed at the same operation, is noteworthy from the fact that out of 59 cases in which both organs were removed, 69 per cent. presented definite gross and microscopic lesions, varying from chronic catarrhal conditions to complete obliteration and chronic periappendicitis. It is, however, well known that chronic changes in the appendix are found frequently in individuals who have never given symptoms which were recognized as appendicitis, and that all the chronic lesions which are found at operation have been found in a series of autopsies made by the writer[18] upon individuals dying of other conditions. The frequency of chronic lesions in otherwise apparently normal individuals arouses the question whether or not 69 per cent. of normal individuals present chronic lesions, or whether this high percentage has any bearing on the lesions in the gall-bladder, in view of the fact that duodenal disturbances are occasionally associated with cholecystitis, and knowing that gastric and possibly duodenal disturbances are associated with chronic appendicitis.

It has very often been observed clinically that many patients presenting themselves with marked discomfort and not infrequently sharp pain in the epigastrium, and a sensation of fullness, bloating, and hyperacidity following eating, do not show any changes in the stomach, duodenum, or gall-bladder recognizable at operation. An exploration of such cases usually reveals chronic appendicitis. After appendectomy the stomach symptoms disappear.

There is at least one inference to be drawn from a carefully studied series of such cases, and that is that the chronic inflammatory process, or the successive mild acute processes without marked localized symptoms, reflexly affect the stomach. This clinical and surgical experience is further strengthened by experimental work. Talma and Clebs[19] produced erosions of the stomach mucosa by continued stimulation of the vagus nerve, which causes contraction of the gastric musculature. Litthauer[20] found that artificially produced hyperacidity in the stomach plus trauma to the mucosa produced ulcers which immediately healed. If, however, he produced an anemia of the part by ligation of the local vessels, the ulceration or erosion remained unhealed. These experiments may have some bearing upon the work of Talma and Clebs, who produced an anemia through contraction of the gastric, especially the pyloric, musculature by stimulating the vagus. They serve here only to bring to mind suggestions regarding known pathologic lesions which occur in the stomach, notably the pylorus. The chain of clinical experience regarding chronic appendicitis, gastric and duodenal disturbances may be strengthened by the experimental work of Roger,[21] who produced gastric hemorrhage by the injection of irritants into the cecum, and by Hedblom and Cannon,[22] who recently have demonstrated a most interesting phenomenon in the muscular rhythm of the stomach and intestines as a result of irritants in the colon. They say: "Not only is the gastric discharge much slower when the colon is irritated, but the passage of the food through the small intestine is greatly retarded." This seems to give strength to the fact that there is at least some definite reflex effect upon the stomach and intestine produced by some abnormal conditions in the large intestine. These facts, although they deal largely with the stomach, may throw light upon the disturbances in the duodenum, which is so intimately related to, and the functions of which are so closely associated with, the liver and bile-passages. The latter are so closely connected with the stomach and duodenum embryologically, anatomically, physiologically, and pathologically that disturbance in one might readily be expected to have disturbing influences upon the other.

The points which have come up during this study, coupled with the two following cases, have strongly aroused a suspicion that possibly the chronic changes in the appendix may reflexly cause disturbances in the stomach and duodenum, which in turn disturb the mechanism of secretion, storage, and outflow of the bile, thereby producing conditions favorable for bacterial infection.

Case No. 31,621, a male, aged fifty-five years, who had stomach trouble associated with belching and distress after eating for eighteen years, during the last fifteen of which he had lost forty-five pounds in weight, presented himself for examination complaining of sour eructations, vomiting of bile, belching, and diarrhea. Vomiting always relieved the pain. A posterior gastro-enterostomy had been done elsewhere four years before. The stomach was enormously dilated, but without an ulcer. The patient died of acute dilatation of the stomach and exhaustion, and presented a chronic catarrhal cholecystitis, a strawberry gall-bladder, and an extensive peri-appendicitis chronica.

The second case, No. 31,501, a male, aged fifty-six, had his first attack of pain in the epigastrium three months before examination. It was referred to the right costal arch. A week later he had severe pain in the same region. This was accompanied by slight jaundice, no vomiting, but fever and constipation. He suffered from gas belching, bloating, and headaches. At operation a large stone was removed from the neck of the gall-bladder, which it obstructed. The patient had a fatal hemorrhage into the bowel. At autopsy an ulcer of the duodenum was found (Fig. 120).

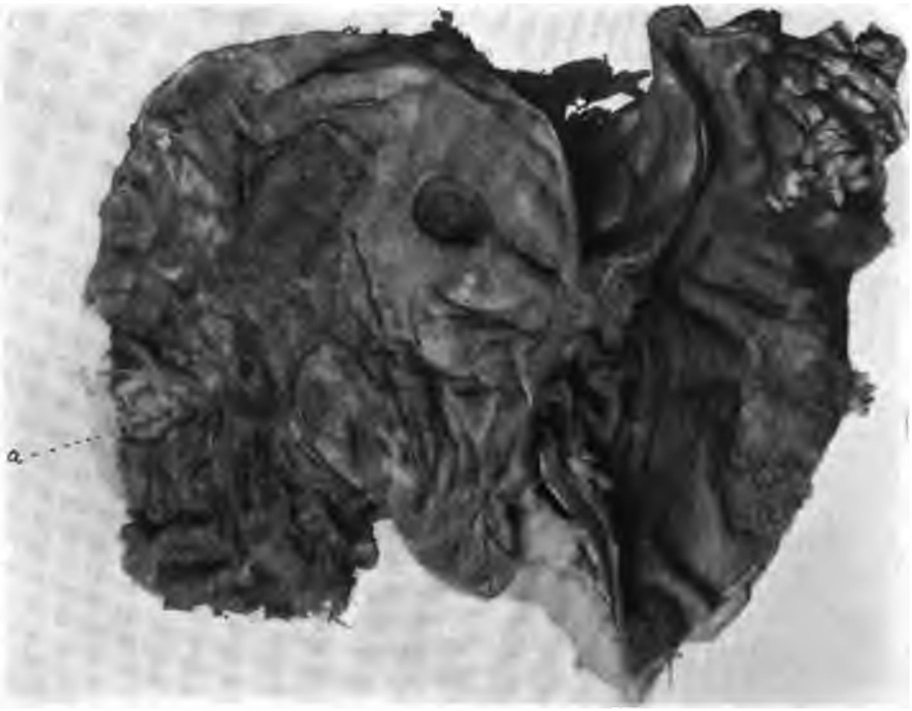

Fig. 120.—Ulcer of the duodenum associated with cholecystitis catarrhalis chronica and stones. *a*, Papilla of Vater. (Case 31501.)

Résumé

1. The gall-bladder, liver, duodenum, pancreas, and stomach are embryologically, anatomically, physiologically, and pathologically closely related, and should be considered a gastro-duodeno-hepatico-pancreatic physiologic system.

2. The pathologic lesions in the gall-bladder are not definite entities but are degrees in a process of reaction to irritants.

3. They may be divided into the following groups:

I. Cholecystitis catarrhalis acuta (Figs. 76 and 77).
II. Cholecystitis catarrhalis chronica (Figs. 78 to 88).
III. Cholecystitis catarrhalis papillomatosa (Figs. 88 to 90).
IV. Cholecystitis papillomatosa malignum.
V. Cholecystitis catarrhalis carcinomatosa (Figs. 91 to 100).
VI. Cholecystitis chronica (Figs. 101 to 108).
VII. Cholecystitis chronica cystica (Figs. 109 to 117).
VIII. Cholecystitis purulenta necrotica (Figs. 84 and 85).

4. Pericholecystitis acuta and chronica occur as sequels of the above-mentioned degrees in the process of reaction.

5. Pathologic conditions in the duodenum are frequently associated with lesions in the gall-bladder and liver.

6. A high percentage of appendices showing chronic and subacute conditions is found associated with cholecystitis and may be an etiologic factor in its production.

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ABDOMINAL PAIN: ITS CLINICAL SIGNIFICANCE*

By GEORGE EUSTERMAN

The ancients rightly termed that portion of our anatomy lying between the thorax and pelvis, the *abdomen*, from the Latin *abdo*, "I conceal." How often has the writer been impressed with the aptness of the name! How, in an unguarded moment, the vague pains of a patient were lightly passed off as unimportant in causation, only to be regretted at some future time!

Unquestionably diagnostic errors in abdominal conditions are frequent, even in this age of scientific progress. One wonders if it is because this particular portion of the human anatomy is more complex in its construction, or because the anatomic topography is more difficult to understand. Even those who have had the opportunity of the widest experience will often overlook a chronic surgical condition, especially if it is complicated by another lesion, or the symptoms of the lesser condition be predominant at the time of the examination. Frequently our errors are more those of omission than of commission. Patients are treated more along the lines of therapeusis than in accordance with the results of a thorough search. Repeated examinations under varying conditions are necessary. For example, in pelvic conditions a case which has been sent in for surgical interference is often cleared up by the element of time and repeated examinations at intervals of a week or month.

Perhaps the most basic element of successful diagnosis is careful, concise history-taking. Thereby one learns the earliest, and often the most diagnostically important, manifestations of the patient's complaint, to say nothing of other lesions, perhaps latent, occasionally uncovered by these measures. In busy routine diagnostic work, how often would the major and minor phases of a case be disregarded were it not that a superior by intuition, or a colleague with a more developed sense of thoroughness, reveals one's shortcomings, to one's discredit or mortification!

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* Read before the Olmsted County Medical Society, Rochester, Minnesota, May 13, 1910.

"The art of surgery, particularly in the abdomen, has made such rapid strides in the past decade that the terms indigestion, constipation, peritonitis, inflammation of the bowels, and other alvine manifestations, no longer stand in a class by themselves, but are collated in a basic system of physiologic reasoning, which results in finding a distinct and characteristic lesion pointing with certainty to the parts involved. The mature and careful consideration of all symptoms involving the viscera and the tracing of this physiologic origin are therefore obviously paramount."

Abdominal pain *per se*, as a diagnostic symptom, may be misleading and confusing. For this reason one should never ask a patient where pain is located, but search for it himself. When one stops to consider the close relationship between the sympathetic plexuses and cerebrospinal nervous system of the abdomen, one realizes how pain may radiate instead of settling in one area. And in the abdomen the anatomic intimacy of the six lower intercostal nerves with visceral and mesenteric plexuses of the splanchnic sympathetic nerves is of primary importance. Again, the pain may be the result of reflex disturbances opening up a line of reasoning uncertain and remote. It is our duty to palpate the painful spot and note the facial expression of the patient, waiving any abnormal mental sensitiveness. Palpation produces the most important sign for successful diagnosis. The examiner should never allow pain alone to influence his judgment until he finds during his examination that it has been caused, or made more severe, by palpating a particular spot.

However tactful and careful one may be, there are patients whose abdominal walls are too fat, or hypersensitive ones who, intractably, make their muscles rigid in spite of reassurance, repeated examination, or different postures. If an individual of this class presents himself, the examination should be either discontinued or continued only when the patient is in a tub of hot water or under the influence of an anesthetic. Let the examination be thorough, irrespective of sex, if there be reasonable justification. A vaginal examination should never be omitted, especially when a woman complains of backache. A pus-tube, a right ureteral stone, or an ovarian cyst is often diagnosed as appendicitis, and a vaginal laceration with retroverted or prolapsed uterus treated for lumbago and kidney disease. Let us not neglect the blood-count and blood-pressure findings.

Barring appendicitis, the majority of painful attacks are limited to the upper half of the abdomen. When the patient presents himself for examination, the age, the physical appearance, the character, and the location and chronicity of the pain are the unconscious factors that naturally present themselves to the mind of the diagnostician, and he may take an offhand diagnosis; but, with as little prompting as necessary, the patient should describe his sensations as he has experienced them as fully as possible, the physician remaining open-minded and holding in abeyance any preconceived views. Then, with all data available and the symptom-complex well in mind, the physician can ask leading questions as necessary to complete the clinical picture.

Affections limited to the upper right abdomen are mostly concerned with the gall-bladder, the duodenum, and the kidney. Ordinarily careful history-taking, the physical findings aided by the radiograph and cystoscope, if necessary, will readily differentiate diseases of this organ. But occasionally, even with all the modern methods of diagnosis, aided by specialized skill, one hesitates at arriving at a conclusive diagnosis. To cite a recent case:

Patient, Mrs. W. A.; married; aged forty-eight years; one child, aged twenty-three years. Four miscarriages (from two weeks to two months; cause not determined). Menopause, two years. Complaint: For past four years brief spells of severe pain commencing in epigastrium passing to the right costal border, radiating straight through to the back and occasionally to the right infrascapular region; sometimes passing downward to the right umbilical area, and accompanied by tenderness and rigidity throughout the right abdomen, most marked in the region of the right kidney, anteriorly and posteriorly; also diaphragmatic colic limited to the right side; nausea; belching; and profuse urination. No hematuria; no fever and no chills; pain not colicky, and gradually disappearing after two or three hours. Last attack two weeks ago. The physician gave a hypodermic of morphin to control pain, and said there was moderate sclerotic icterus. Examination showed tenderness and rigidity most marked at the level of the right kidney through to the back, and in the right iliac fossa. Urine, negative; pelvis, negative. Tentative diagnosis: gall-stones.

Cystoscopic examination of both ureters and pelves, negative. Radiograph showed a definite shadow of a soft stone in the region of the right kidney. Collargol plate proved that the shadow was not intimate with the kidney pelvis, but probably in the cortex. Shadow apparently too low for gall-stones, because it was lying parallel to the plane of the kidney.

Diagnosis: Stone in the right kidney. Exploration of appendix and gall-bladder from posterior incision. Operation revealed a prolapsed gall-bladder filled with stones. The kidney was negative. However, the gall-bladder was drained and the stones were removed through a lumbar incision. The patient made an uneventful recovery.

This is one of the many cases showing the impossibility of a conclusive, accurate diagnosis in abdominal lesions.

Ordinarily gall-bladder disease is not difficult of diagnosis, if not complicated by adhesions to neighboring structures, like the stomach and duodenum. The characteristic and significant symptoms are: (1) chronic, long-continued, or recurring indigestion; and (2) the phenomena designated as gall-stone colic. The symptoms of chronic, long-continued, or recurring indigestion are of the utmost importance, and are commonly misinterpreted. It is now well known to surgeons, although less widely acknowledged by general practitioners, that the symptoms ordinarily denominated "gastralgia," "stomach trouble," "indigestion," "dyspepsia," etc., are due, in many cases, to disease of and about the biliary tract.

"Gall-stone colic usually develops suddenly, with severe, often agonizing, pain in the right hypochondrium or the epigastrium, radiating around the chest or to the right scapular region, nausea, vomiting, and prostration, weak, rapid pulse, rapid heart-action, and profuse perspiration. Sometimes the severe pain lasts for a few moments only; usually it lasts for from two to twelve hours. The pains of cholelithiasis may be colicky or non-colicky. Jaundice may or may not be present." The clinical picture may be shaded by the presence or absence of cholecystitis, cholangeitis, empyema of the gall-bladder, a stone in one of the various ducts, pancreatitis, etc.

In other painful affections about the gall-bladder or the liver the clinician must bear in mind the possible presence of acute or chronic hepatitis, diaphragmatic pleurisy, subdiaphragmatic abscess, hydatids of the liver, and the hepatic crises of myocardial incompensation.

The diagnosis of kidney lesions, aided by the cystoscope, radiograph, and functional tests, approaches pretty near an exact science. That left-sided chronic pain, the *bete noir* of the profession, may be due to hydronephrosis, a loose or tuberculous kidney, an ovaritis, gastric ulcer, or to a diseased condition of the gall-bladder. To cite an instance of the latter condition: I have now under observation a case which, along with pelvic troubles, was suspected of having gall-stones on account of a history of chronic indigestion, painful attacks, and tenderness limited to the left costal border and left scapular region. In the routine exploration of the abdomen during an operation for a subtotal hysterectomy, a thickened gall-bladder containing two large stones was palpated.

The multiplicity of painful symptoms referable to the epigastrium is familiar to all of us. Lesions of functional disorders of the stomach, the initial symptoms of biliary and hepatic disease, and pancreatitis are the commonest types. In the young adult the physician is mindful of reflex symptoms from diseased conditions of the appendix and cecum, not forgetting the motor gastric neuroses, pylorospasm, and cardiospasm. These latter two entities may be as often dependent upon organic as upon functional derangement. Again, there are the abdominal manifestations of organic diseases, such as the gastric crises of tabes. The writer recalls five distinct cases of tuberculous disease of the uterine adnexa which so closely simulated inflammatory disease of the gall-bladder that, judging from the patient's own history, one would scarcely look for so remote a condition as pelvic disease having any etiologic bearing. One must not forget to include the referred painful symptoms, which are often very acute, of organic heart or arterial disease. "Much attention has been paid of late years to abdominal symptoms of arteriosclerosis. Pal and others believe that many of the painful gastric and intestinal conditions are associated with spasm in the gastric and mesenteric vessels; some would associate the multiple functional disturbances of abdominal neurasthenia with degenerative changes in the arteries. The victims of angina pectoris may have marked abdominal symptoms, and of late writers have spoken of such attacks of abdominal pain as *angina abdominis*.

"Milder attacks of epigastric pain and intestinal cramp and meteorismus have been attributed to arteriosclerosis. The clinical features of gastric and intestinal dyspnea have been regarded as manifestations of circulatory disturbance in the sclerotic vessels. Even an intermittent claudication of the stomach has been described."

A case of this so-called "angina abdominis" was under observation recently in the clinic of St. Mary's Hospital. The history is as follows:

Male, aged fifty-five years; robust appearing half-breed rancher with antecedent history of alcohol, possibly lues, was referred to us for gall-stone disease. For over fifteen years, at irregular intervals of two months to a year, he was subject to sudden severe attacks of pain in the right epigastrium, spreading diffusely over the upper abdomen. Relief was usually obtained by morphin, given hypodermatically. There was no final localization, rarely epigastric disturbance, and no jaundice. (The latter symptom, barring stained conjunctivæ, would be hard to determine owing to his dark skin.) His radial and femoral arteries were sclerosed; there were present the intermittent characteristic pulse of chronic myocarditis, an accentuated aortic second sound, and cardiac enlargement of 3 cm. to the left of the nipple line at the level of the fourth costal cartilage. His systolic blood-pressure was 180 mm. He had an unusually severe spell while under observation. The blood-pressure during the attack was 220 mm. Radial pulse was full and bounding and obliterated only by firm pressure. A marked feature of the case was a temperature of 104° during the attack and agonizing pains throughout the limbs.

A cursory examination of the nervous system gave us no evidence of luetic disease. Prompt administration of amyl nitrate without opiates caused gradual amelioration of the symptoms and a fall of 70 mm. in blood-pressure. This confirmed the diagnosis, which was further substantiated by marked improvement through the daily administration of iodids combined with nitrites, and regulation of personal habits and mode of living.

This case is not unlike one reported recently by Lewellys Barker, which showed a painful paroxysmal splanchnic arteriospasm with hypertension in the gastric crisis of tabes.*

As regards organic diseases of the stomach, particularly ulcer and carcinoma, pain or distress is an invariable symptom. Bearing in mind that pain is always present to a greater or less extent during the functional activity of this organ, one has the keynote to a differential diagnosis in visceral lesions of the upper abdomen. The midnight or early morning attack of cholelithiasis is almost proverbial.

The lower abdomen is chiefly concerned with the much abused, much removed, but frequently diseased appendix. The frequency of disease in this organ has given a great impetus to the surgical treatment of intra-abdominal lesions. The pain of a right ureteral stone, ovarian cyst, salpingitis, the tuberculous coxitis of children, tuberculous or malignant disease of the cecum, has been often mistaken for inflammatory disease of the appendix. Besides this very frequent cause of pain in the lower abdomen, there are other and rarer possibilities of benign inflammatory and malignant tumors of the intestinal tract; the various forms of colitis, enteritis, intestinal colic, whether of functional or organic origin, tuberculous peritonitis, or lower abdominal manifestations of pelvic disease. Or we may be dealing with complications like the perforation of enteric fever, the enteralgia of hysteria, or organic spinal disease.

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* "Am. Jour. Med. Sci.," May, 1910.

These are all glittering generalities, but one is impressed with the possibilities of the "belly-ache." Unlike diseased conditions of the upper abdomen, we do not have such valuable and familiar diagnostic agents as the radiograph, the cystoscope, and the test-meal to aid us in differentiating trouble in the lower abdomen; but by tactful use of hands and eyes, by our increasing knowledge concerning the physiology and metabolism of the alimentary tract, aided by bismuth-Röntgen plate and the sigmoidoscope, the interpretation of lower abdominal pains is placed on a more scientific basis than it formerly held.

INTESTINAL OBSTRUCTION: AN OUTLINE FOR TREATMENT BASED UPON THE CAUSE OF DEATH*

A STUDY OF FOUR HUNDRED EXPERIMENTALLY PRODUCED LESIONS

By J. W. DRAPER MAURY †

Physiologists often quote the sentiments of Montaigne: "With how little anxiety do we lose the consciousness of light and of ourselves." By this they would convey the idea that the act of dying is as painless as the act of falling asleep, and also as little perceived. Nevertheless so strongly rooted in the human mind is the desire to live that the profession of medicine has for its chief purpose the lengthening of human life. Hence it is natural that the study of the causes which bring death to a cell, to an individual, or to a race of men has for long been a favorite and engrossing one. None of us without giving thought can realize how many and how different are the actual and underlying causes which terminate life. "The supreme fact," says Adami, "that sooner or later death comes to all men has profoundly affected all human thought, and the various religions of the world may be regarded as the evidence of man's determination to rise superior to the dissolution of his body." In the unicellular organism there is no destruction of the essential living matter but a multiplication thereof: each spore carries on the life. There is no death in the ordinary interpretation of the word. "It is with the appearance of the multicellular organisms that natural death enters into the world." In the cellular differentiation it comes about that the germ cells are given the inherent power of perpetual life, while the somatic cells, through the elaboration of which the individual organism reaches its final development—side-tracked groups, as it were—are destined to hold and live together for a span and then to undergo dissolution.

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* A research conducted under a grant from the Rockefeller Institute for Medical Research, and presented at a meeting of the Johns Hopkins Medical Society, Baltimore, March 1, 1909. (Reprinted from "Am. Jour. Med. Sci.," May, 1909. Copyright, 1909, by Lea and Febiger.)

† These studies are being continued at the Laboratory of Physiological Surgery, St. Mary's Hospital, Rochester, Minnesota.

There are in general two forms of death which may befall the somatic cell—the physiologic and the pathologic. The pathologic form of death may be induced by mechanical, physical, chemical, or bacterial agents. With these in this paper, which deals with the cause of death in duodenojejunal obstruction alone, I hope to demonstrate that we are not concerned. Physiologic death, on the other hand, that form of dissolution of somatic entity which has been studied so thoroughly, so exhaustively, in the pioneer work from the Johns Hopkins laboratories, the death following parathyroidectomy and that associated with adrenal and pituitary destruction or removal, this physiologic form of death is that which immediately concerns us. I understand physiologic death to comprise not only the dissolution which follows the removal of certain substances by destruction of their secreting cells, such as the parathyroid, but also that dissolution of somatic life which is brought about by the mechanical interference with detoxication of the normal secretions of the body. Putting it concretely, I may say that a barrier which may prevent the normal distribution of enterokinase, or the normal reaction of anti-enzyme upon enzyme, is the cause of death which is physiologic and somewhat of the same type as is the death brought about by removal of glandular secretions, so-called internal in character. It is not to be denied, of course, that these thoughts suggest ascribing to the duodenum a function, I believe, hitherto and as yet unknown, that of internal secretion.

In whatever manner this may be rightly considered, I ask you to allow me to start with the hypothesis that the intestinal barrier which closes the lumen works no ill to the organism save through an interference with the physiologic exchange or balance of the duodenojejunal secretions, and that the resulting death is physiologic in type. I ask you to assume for the moment—and for this we have adequate proof—that in intestinal obstructions there is no appreciable damage to the individual through the nervous system from the direct trauma of the obstruction; that there is no lethal infection of bacterial origin; that the element of decomposition of food does not enter into the picture at all—in short, that all pathologic forms of death are eliminated. I shall strive to detail to you the simple, and withal possibly inefficient, measures which I have taken in my efforts to prove these things to myself.

Nervous Effect of Intestinal Trauma.—Clinically surgeons have recognized a difference of degree in the shock produced by cutting the intestine in various places: the nearer one approaches the pylorus, other factors being equal, the greater the shock. Indeed, in the execution of the well-known pyloroplastic operation devised by Finney, it has been, I believe, commonly recognized that a shock to the patient might occasionally be clinically noticeable at the moment of actual section of the pylorus. Operations which will be described later and in the course of which this highly sensitive mechanism was entirely removed or seriously injured, and furthermore operations in the remotely aboral portions of the small intestine which technically were associated with precisely the same amount of traumatism as those in the duodenum and jejunum, afford, under study, point-blank evidence that the nervous shock or reaction (let it be called what it may) has nothing whatsoever to do with the cause of death in the form of intestinal obstruction under consideration. Indeed, I have been led to the conviction that the infliction of even unusual mechanical traumas incident to various operative procedures upon the alimentary canal, not excepting the thoracic esophagus, is incapable of producing more than a transient and unimportant nervous reaction. It stands to reason that if a dog will live for weeks with iliac obstruction yet dies at the end of a few hours with duodenal obstruction, and that if the same dog can be made to live also for weeks, if but the slightest drainage be instituted, something far more important than mere mechanical injury is the cause of death. Obviously the traumatism in each case is equal. Incidentally it may be noted that whatever nervous traumatism might be associated with the dilatation of the proximal loop would presumably be greater where the greater dilatation occurred. In the majority of fatal cases of duodenal obstruction there was little or no dilatation; it rarely has time to develop, whereas in the chronic aboral obstructions it is frequently found.

Infection of Bacterial Origin.—No one could pretend to read the literature of intestinal obstruction and not be acquainted with the contributions which have been made from the Johns Hopkins Laboratory on the subject of bacterial emigration oral to the obstruction. These studies have contributed widely to our knowledge of the pathologic type of death which unquestionably occurs from obstructions in the aboral portions of the ileum and from occlusions of the great gut. It is, however, the physiologic form of death alone with which I am concerned; with the fulminating prairie-fire-like toxemias which, unheralded and often in a few hours, destroy the victims of duodenal obstruction. In dogs the clinical syndrome is usually typical; the muscular tremors localized in certain groups of muscles, the tachycardia, the rapidly advancing coma and death, followed by a characteristic stiffness. Clinically this picture is not far different from that observed after parathyroidectomy.

The pathologic form of death which results from obstruction at or near the ileocecal valve, and which may well be of bacterial or stercoraceous origin, has not been the special object of our study, and of it, therefore, I am not qualified to speak. I would note, however, in passing that it is slow and tortoise-like in overtaking the somites, suggesting in every detail a process quite different from that which has been the special subject of my studies. Furthermore, it should be noted that while the duodenum possesses a rich flora, it is exceedingly poor, at least in the healthy dog, in pathogenic forms, and Continental observers, as well as your own, have found blood-cultures taken from cases of duodenal obstruction entirely sterile.

With these premises then I ask you, for the academic purposes of argument, to assume that in obstruction of the intestine two entirely separate and distinct forms of death are to be differentiated: the one duodenal and purely physiologic, due to an unknown disturbance of the duodenal secretion or balance, the other ileocolic and purely pathologic; the one a true auto-intoxication, the other a true exo-intoxication.

Duodenal Autointoxication.—The following impressions have resulted from the study of over 400 cases of duodenal or orojejunal obstruction produced experimentally during the past five years at the Surgical Research Laboratory of Columbia University. Although the series is not small, the positive conclusions which are offered by it are regretfully small. This may be attributed in part to the natural deficiencies of the experimenter and to the great intrinsic difficulty of the task, and also very fairly in part to the fact that the work has been done at odd moments taken from an annoyingly engrossing practice and amid surroundings sadly incomplete and unfit. I mention this because I seek your indulgence.

A chronicle of the steps which have led to the above outlined position on intestinal obstruction is as follows: About five years ago, while modifying the McGraw elastic ligature so as to substitute common every-day twine for the perishable elastic, and also with a view to remove sizable apposed portions of gut and stomach wall, Weir at the time considering this a necessary part of the technic, we were suddenly confronted by the perplexing coincidence that all our animals died. There was no peritonitis; there was no gross lesion discoverable within or without the abdomen. We noted an early rigor mortis, and that before death the heart-beat was accelerated, the gait was peculiar, owing to spasticity of the hind legs, and there were well-defined muscular twitchings. The technic had embraced the closure of the duodenum (Fig. 121). At that time no information was forthcoming as to the cause of these phenomena and I could find nothing regarding it in the literature. It was not long, however, before Roger, in France, began an allied series of experiments which to some extent corroborated our own findings. All these experiments, as well as the most recent ones, have been based on the utilization of this potential gastro-enterostomy by the twine triangular ligature as a control. It seems reasonable, and indeed is easily susceptible of proof, that the twine will cut out and give drainage in healthy stomachs of normal dogs at about a constant time—seventy-two hours. It is a coincidence of import that the physiologic death which we have been studying usually takes place in about the same time as is necessary for stoma drainage to begin. Thus we have come to regard the cutting out of the stoma as a sort of index of resistance of the individual to the intoxication process, and we have proceeded to create different

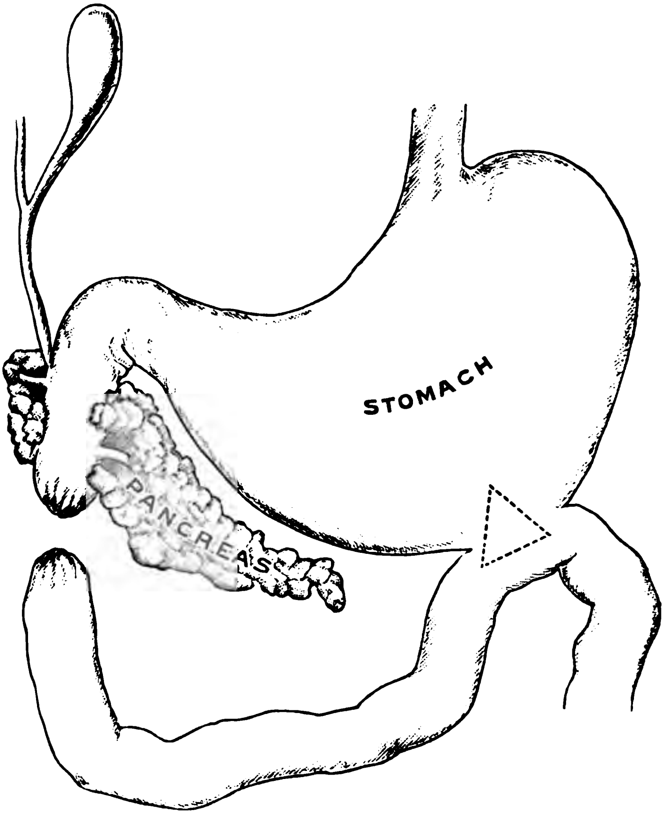

Fig. 121.—Duodenal obstruction; twine triangular control. In this class of experiments the bile and pancreatic fluid do not drain. Death before stomach drainage almost invariably occurs irrespective of the presence or absence of food in the stomach. This short-loop type should be given retrograde lavage or anti-enzyme serum from the long-loop class.

degrees of toxicity, which we found we could do by varying the position of the obstruction and of chronicling the results in terms of gastric drainage. For it should be noted that almost any form of drainage, whether through the normal channel of the gut, or abnormally through the stomach or even through an entero-anastomosis of the aboral loop with the oral loop, will counteract the lethal effects of what we believe to be a physiologic death, due to a disturbance of physiologic intra-enteric enzymotic balance.

Determination of Aboral Lethal Line for Physiologic Death.—Logically the first step after determining by a long series of experiments that death followed the closure of the duodenum before drainage became established through the triangular stoma, was to ascertain the effect of practising a similar technic, but modified by placing the obstruction in the jejunum (Fig. 122). Another lengthy series of experiments determined, I believe with reasonable accuracy, that death would not occur in a medium-sized dog until after the free drainage of the stomach, that is, several weeks, in any case when the obstruction lay more than 35 cm. aboral to the pylorus. This distance probably varies somewhat according to the size of the dog. The individuals exposed to this type of experiments will in future be referred to as the "long-loop dogs." For to them on account of the possible production of anti-enzymes, or protective bodies of unknown character, there attaches a particular and perhaps a lasting interest. These long-loop dogs, barring ordinary accidents, survive the moderate toxemia to which the obstruction gives rise and will live often for several months without apparent discomfort or loss of body function. On autopsy, the oral segment was found to be but moderately dilated, as a rule, and the evenness of digestive function suggested the phenomenon of gastro-proteid digestion. But the theoretic considerations which offer themselves as a result of this particular group of experiments must not interfere with this chronicle of plain observed facts.

Determination of Oral Lethal Line for Physiologic Death.—The next step naturally was to determine the oral limits of the point of obstruction beyond which one might go and not encounter physiologic death within the time limit of triangular control. Because of the studies of Roger upon the gastrotoxins, and of the recent publication of Bolton describing a gastrotoxic serum, it is of very great importance to know whether the lethal bodies take their origin from the gastric mucosa, from the pancreatic fluid, or from the duodenum. Roger states that simple ligation of the pylorus leads to this physiologic death in from seventy-two hours to five days. That, it will be observed, is just without the limit of the twine triangular time control. It is true that Roger did

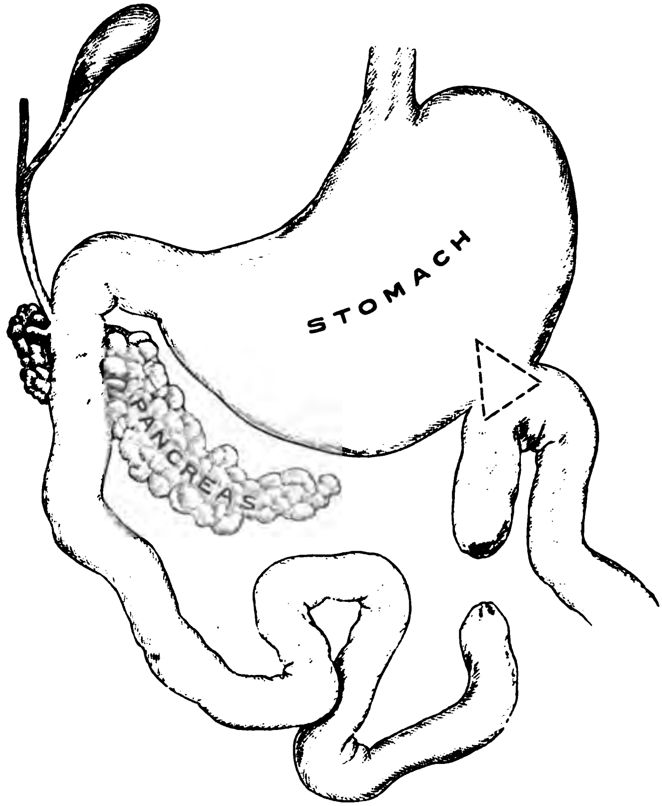

Fig. 122.—Jejunal obstruction. The length of the oral loop was more than 35 cm. In this class of experiments the dog lives until the twine cuts the stoma and often for months thereafter. Obstruction between this (35 cm.) and the greater pancreatic duct is almost always fatal before gastric drainage begins. Does the intestine detoxicate by the addition of an anti-enzyme, or does it save life by offering a larger field for absorption, thus diluting the toxic elements? This long-loop class may furnish a protective anti-enzyme serum for use in the short-loop class.

not employ the delayed gastro-enterostomy for a control, and so much that is accidental is certain to enter into all this sort of work that one feels hesitancy either in commenting upon the results obtained by others or in impressing one's own experimental findings. It is true, however, that we have observed this fact: Given free drainage of the duodenum through the normal channel, as shown in Fig. 123, the stomach may be obstructed at or near the pylorus more frequently without lethal result until the cutting through of the triangular stoma than if the obstruction were in the duct-bearing portion of the duodenum. Of course, in this type of experiment, with the cutting through of the stoma, there ceases at once to be a reason why the animals should not live for

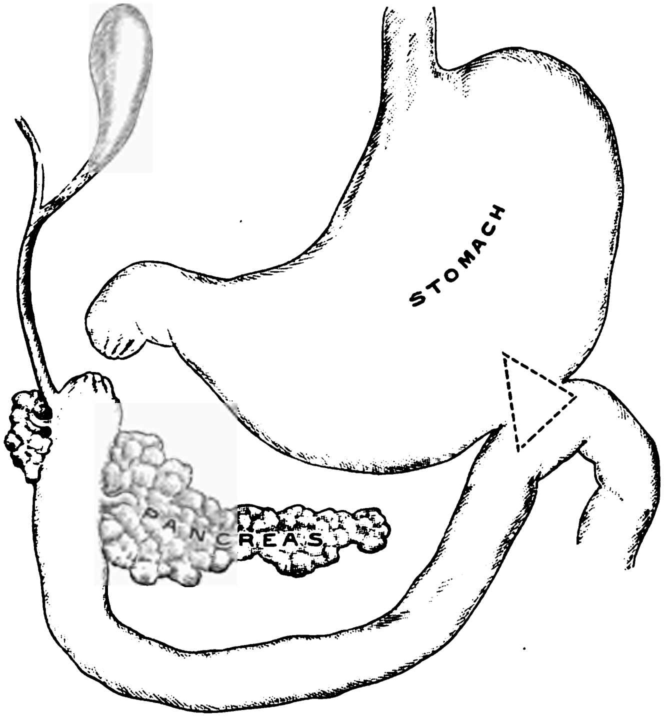

Fig. 123.—Duodenal obstruction; twine triangular control. Both the pancreatic fluid and the bile empty into the aboral loop. In this class of experiments there is usually no fatal outcome during stoma control, even if the stomach contains food at the time of the operation.

an indefinite period. I do not wish to be understood as saying that no physiologic toxic elements arise from the stomach and that the source of the toxicity is strictly duodenal or pancreatic; but we have been struck by the fact that, discounting all consideration of biliary toxemia, which one seems quite justified in doing, at least the chief source of the poison is either in the duodenum or in the pancreas. In the light of our present knowledge, and measuring the degree of toxicity by our time drainage unit, rather than attempting to measure it, as Roger has done, in terms of toxic units, we were led to assume that the source of the toxemia was not in the stomach but in the duodenum. This enabled us, for purposes of study, at any rate, to place the oral limit of the lethal line between the pylorus and the papilla of Vater, because until now the question of the influence of the bile has not yet been worked out.

The duct-bearing portion of the duodenum has long been recognized as an area having unknown and profoundly complex physiologic properties, and it is in part the object of this paper to demonstrate that the most accurate interpretation and knowledge of the physiologic processes going on in this short tube must form the groundwork for future therapeutic progress, be it surgical or medical; not alone on the alimentary canal, but, as one should logically expect, as well upon its great glands, the liver and the pancreas. The morphologic relationship of the stomach, liver, and pancreas to the duodenum has been graphically portrayed by Mumford, who says that the pancreas, the liver and ducts, and the stomach hang like three apples on a single stem, the duodenum. Whatever affects one often affects the others. What more striking simile could one have? I submit that our studies have carried us still farther, and that we are justified in considering not only the morphologic relations, but also the physiologic relations, as fixed. Is it not significant, in view of the close morphologic relationship of these organs, that we have from unknown causes fatal hemorrhages into the pancreas, fatal dilatation of the stomach, fatal sequels to biliary operations which are not properly drained? I leave the discussion of this to those more qualified to speak of it than I, and continue with the narration of our experimental observations.

Elimination of the Bile by Duct Ligation; Cholecystenterostomy and Transplantation of the Point of Discharge into the Duodenum.— A long series of experiments, painful to the operator in point of technical detail, was created by which the bile was intended to drain into the ileum by the use of the ordinary suture opening between the gall-bladder and the gut. For some reason, however, although the technical part was accurately executed, there was in every case a failure of the bile to drain. We finally concluded

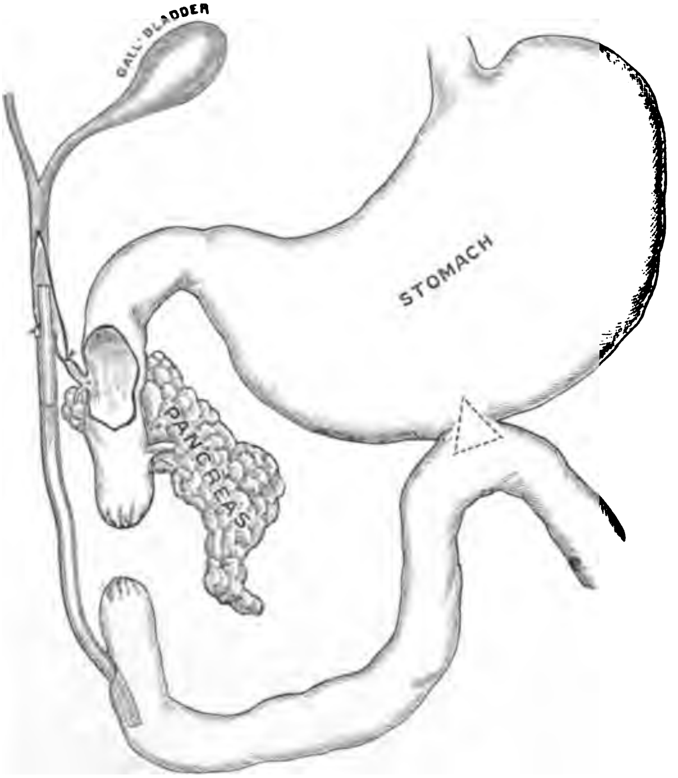

Fig. 124.—Extra-enteric tansposition of the biliary secretion (Sullivan's technic). A glass cannula is inserted in the common bile-duct; a rubber tube over the glass is stitched to the cut margin of the duct and introduced within the gut aboral to the intestinal obstruction. The bile-duct is tied at the entrance to the duodenum.

that there was either a change in its composition, owing to infection from the ileum, or that the secretory function of the liver-cells had been abandoned or changed to an absorptive one. In any event, the bile draining or not draining, it was not possible for it to enter the oral loop, as the common duct had been ligated and divided, but the results, so far as the physiologic death went, were the same. Death occurred in short-loop dogs before stoma-control drainage. To fortify the position and to enable us to feel that we were not superimposing hepatic changes upon those under consideration, Arthur Sullivan, the senior laboratory assistant, devised

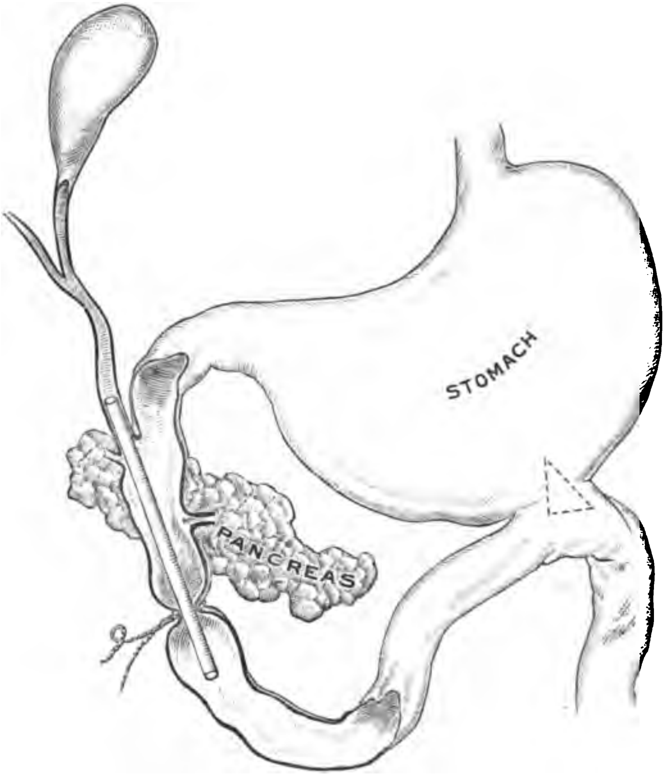

Fig. 125.—Intra-enteric transposition of the biliary secretion; twine stoma control. The forepart of the gut is shaved off to show the tube in position. This technic is difficult of execution and is further objectionable in not permitting actual section of the gut at the point of obstruction. There is apt to be leakage of the intestinal contents around the tube. This vitiates the experiment.

means for the direct transplantation of the bile (Figs. 124 and 125). It comprises the reconstruction of the common bile-duct, and will form the basis of a communication from him at a later date. The use of this simple and effective technic allowed of sufficient room between the transplanted biliary intake and the greater duct of the pancreas, either for complete section and invagination of the duodenum, or for its ligation, as the case might be. Here, again, a sufficient series of experiments demonstrated that the supposed toxicity of the bile, at least in regard to obstructive death, was

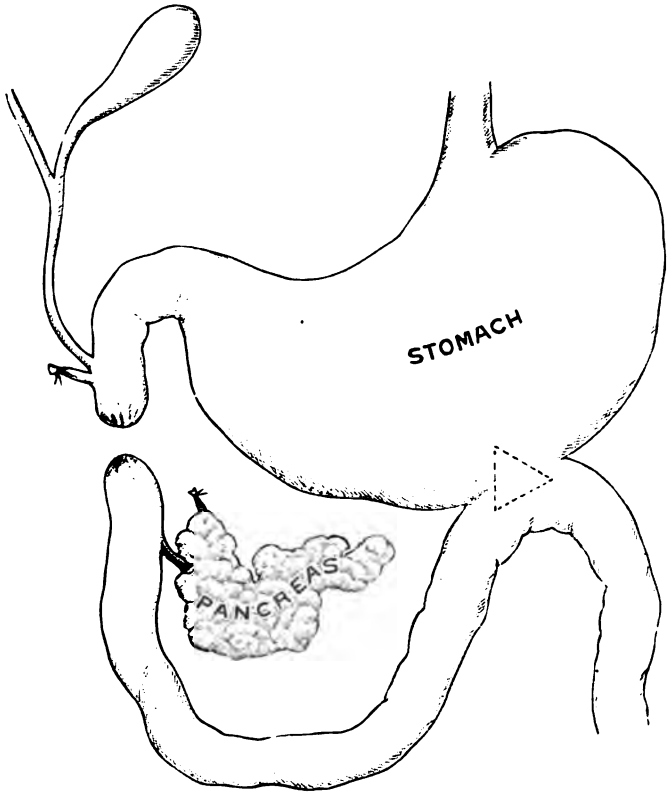

Fig. 126.—Duodenal obstruction between the pancreatic ducts; twine stoma control. The duct of Wirsung is tied and cut so that bile alone enters the oral loop. Drainage of the pancreas by the greater duct is adequate to prevent undue hardening or fat necrosis. The gland continues macroscopically in good condition. Dogs usually live during the period of stoma control.

erroneous. It did not matter whether the bile emptied into the oral (Fig. 126) or aboral loop near the point of obstruction, whether the duct was simply ligated and cut, or whether cholecystileostomy was done, the lethal outcome appeared rather conclusively still to be dependent entirely upon the position of the obstruction. In other words, bile, the salts of which are known to possess a very measurable degree of toxicity, was in no way connected with the physiologic death under observation.

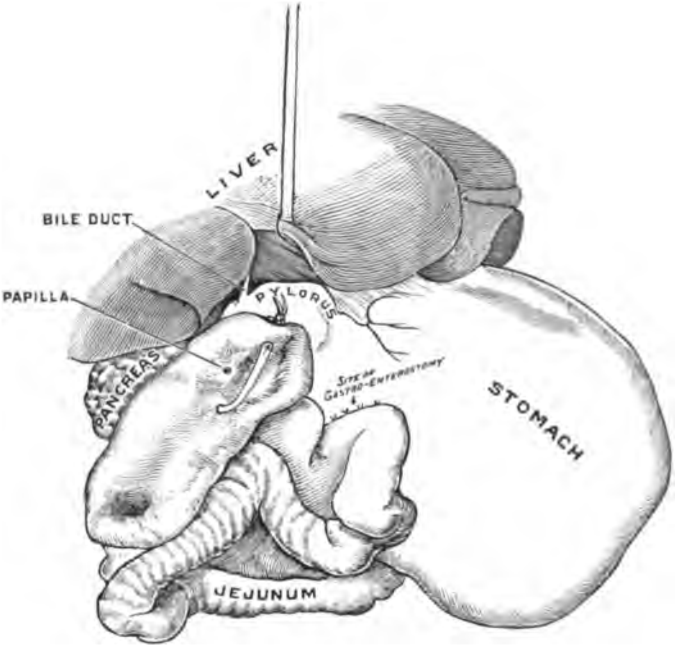

Fig. 127.—Attempted transposition of the pancreatic secretion oral to the duodenal obstruction produced by a ligature. The bile drains aborally. The lesser pancreatic duct is ligated.

Relation of the Pancreatic Secretion to Intestinal Obstructive Physiologic Death.—The morphology of the parts does not allow a transposition of the pancreatic secretion, in the first place, because there are two ducts; and, in the second place, because they are very short and firmly fixed to the pancreatic tissue (Fig. 127). Any interference with this, no matter how delicate, may lead to fat necrosis and other conditions which confuse the point of issue. By using Sullivan's tubes, however, we were able to move the point of entry of the bile as many centimeters aboral to the papilla of Vater as was convenient. After ligating the lesser duct at its point of entrance beside the papilla and cutting it, we could make certain of having sufficient room to sever and invaginate the duodenum in such manner that all the pancreatic secretion might enter into the oral or the aboral loop. Opie has commented on the fact that drainage of the greater duct would usually suffice to prevent any undue hardening of the pancreatic gland because of retained secretion, and we have been glad to make use of his observation by tying and cutting the lesser duct. The result of these studies was conclusive in one regard: irrespective of the whereabouts of the discharged bile, the dogs lived during stoma control when the pancreatic secretions drained aborally, and they died during stoma control when it was confined in the oral loop. I ask that this be not interpreted too positively, because enough conclusive work has not yet been done to justify too positive conclusions. This may well be pardoned, because of difficulties arising from the excessive sensitiveness of the duct-bearing portion of the duodenum, but we have gone far enough to justify our asking for corroborative evidence from others.

We understand that the secretions of the gastric mucosa may be toxic, and that this toxicity may be increased many thousands of times by an oral intestinal obstruction, but we have accomplished enough strongly to suggest at any rate that, whatever may be the nature and degree of this toxemia, a toxemia which develops from a disturbance in the duct-bearing portion of the duodenum contains poisons of a much graver nature. It is presumably not to be denied that the increase in amount of gastrotoxins noticed after pyloric obstruction may well be brought about by the interference of a normal duodenal limitation of such toxin development. It is a point of perhaps more than academic interest that Weinland has found an antitryptic ferment to exist in the oral portion of the small intestine. Is one justified in supposing that, as the pancreatic juice, grossly at least, appears to be the lethal agent, the danger from intestinal obstruction grows less and less the farther one places it from the pylorus, and therefore more and more in the antitryptic bearing portions of the canal, and this because of zymotic action? I do not wish to be understood as stating or even suggesting that trypsin alone or as such is responsible for the phenomena; no doubt there are many other ferments and antiferments

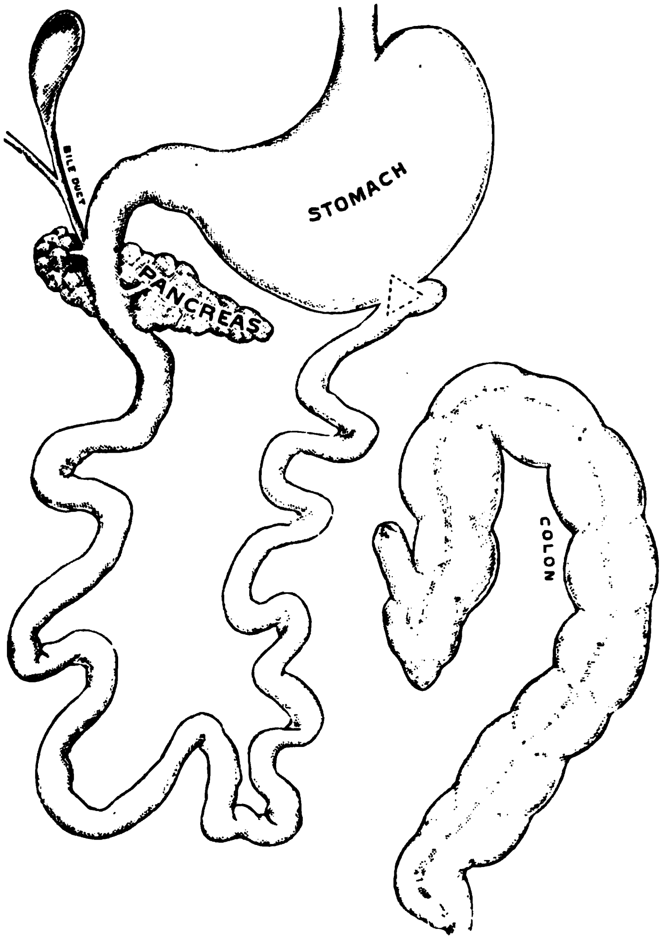

Fig. 128.—The entire small intestine forms the loop. The dogs lived several weeks.

occurring in the duct-bearing portion of the duodenum, but I speak of the trypsin simply as a representative of the class, because I understand its antibody to have been definitely found. It may indeed be that there is some form of internal secretion produced by the duodenum, possibly not directly associated with the processes of digestion, which is the fundamental factor in causing this physiologic form of obstructive death. This should be capable of demonstration by experimental methods. Some such hypothesis is at present necessary in order to explain the singular phenomenon of the protective power of the first 35 cm. of the intestine, the

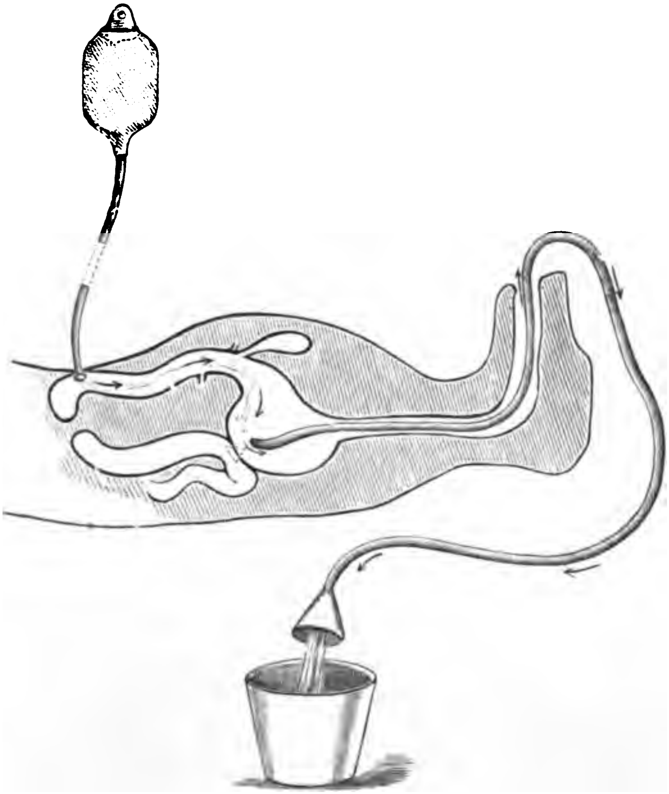

Fig. 129.—Retrograde lavage in a dog. This removes the toxic duodenal products quicker and more thoroughly than ordinary lavage.

presence of which in the oral loop sufficed to prevent death before the opening of the triangular control. It may also explain the curious conditions shown in Fig. 128.

Therapeutics.—So far the suggestions as to treatment for these dogs have been based upon the belief that we had shown the region of maximum toxicity to be the duodenum rather than the stomach. It seemed, therefore, logical to irrigate the entire region rather than the stomach alone, and this by a sort of retrograde flushing (Fig. 129). This in a dog is easy to accomplish, the pyloric sphincter offering no obstruction either to alkaline or to acid irrigation. It is conceivable that some modification of this method might possibly be employed upon the human being, for constant irrigation of the duct-bearing portion of the duodenum would seem on experimental grounds to be the one logical method of preventing the absorption of the physiologic poisons referred to.

A more philosophic method of meeting the conditions might be to transfuse the sick short-loop dog from a long-loop dog, which may be supposed to have manufactured, in the course of his temporary illness occurring before the establishment of gastric drainage, certain antibodies which might be protective to the short-loop dogs. We have done a little work in transfusing the long-loop into the short-loop dog, and have noted improvement in the latter; but this might come from accumulation of the fresh blood rather than from the presence of anti-enzymes. We are, therefore, endeavoring to obtain a serum from the long-loop dog, with which we hope to tide the short-loop dog over his period of hypertoxicity, so that he too may live until the triangular control gives gastric drainage and assures permanent life.

INTESTINAL OBSTRUCTION DUE TO KINKS AND ADHESIONS OF THE TERMINAL ILEUM*

By CHARLES H. MAYO

Added to the list of reflex symptoms originating from the appendix, there are certain symptoms caused by partial obstruction of the lower ileum which somewhat resemble those from obstruction of the stomach or intestine, but they are less severe and more chronic in character. We are all familiar with the marked stomach reflex in obstruction of the small intestine, and experiments have shown how readily in this condition the small intestine reverses its peristalsis. We are also familiar with the marked reflex (though to a less degree) of the stomach in cases of cystic appendicitis and moving concretions of the appendix. It is quite apparent that the stomach is the center of effect from many reflex sources of both the conscious and subconscious nervous system. To such an extent is this true that approximately only one individual in ten who complains of apparent serious stomach trouble ever has any real lesion of this organ.

In its development the mid-intestine consists of all the small intestine below the common duct, and includes the cecum and appendix as well as the ascending colon and part of the transverse colon. About 10 inches of the ileum is pelvic, and originally it is fixed to the lower end of the cecum. This attachment—which is, in addition, the opening into the cecum by lateral union—should, and usually does, become detached about the period of birth; when it does not, we have additional reason for obstruction. The ileum may have a comparatively short mesentery at its termination above the pelvic brim, and at times the cecum has a true mesentery permitting a considerable range of motion.

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* Read before the Western Surgical and Gynecological Association, Dec. 20, 1910. (Reprinted from "Surg., Gyn., and Obstet.," March, 1911.)

For a number of years past, in dealing with intestinal stasis believed to be due to a diseased condition of the appendix, in which the seriousness yet obscurity of the symptoms required a larger incision for exploration than was usually made for the removal of the appendix when it was unmistakably diseased, and the symptoms more definite, we have, at times noted a definite kink of the ileum within 3 inches of the ileocecal valve. However, the frequency with which the condition was seen in certain cases did not occur to me until a few years ago when my attention was personally called to it by W. Arbuthnot Lane * (Fig. 130). Arbuthnot Lane has undoubtedly had a most extensive experience in the surgical treatment of serious chronic constipation, and he believes that the adhesions found in the kink of the ileum and in the appendix have added to the obstruction and

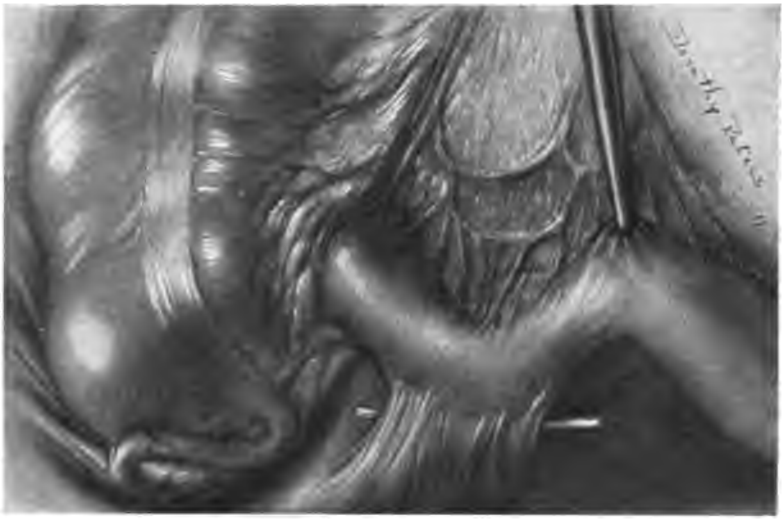

Fig. 130.—A form of Lane kink with adhesions.

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* W. Arbuthnot Lane: "The Kink of the Ileum in Chronic Intestinal Stasis." (James Nisbet & Co., Limited, London, 1910.)

tended to the development of appendiceal concretions from retained fecal contents in the organ. He also believes that the condition is not necessarily inflammatory, but is the natural result of the tendency of the heavily loaded fluid contents of the cecum to descend to the pelvis owing to the erect position of man, and, therefore, the bands are developed in the lines of traction force. There is found a short and firm attachment of the lower ileum, and an attached or short appendix with ptosis of the cecum. The ileum is rolled over and becomes adherent to the peritoneum beneath it.

Two years ago Jabez Jackson* presented a paper before this society in which he reported certain cases of appendicitis showing, at operation, a veil of new-formed peritoneum over the cecum and ascending colon. Jackson claimed that where this veil existed the patients were not often cured by the removal of the appendix, but that they could be cured by the removal or partial removal of this adventitious peritoneum. We believe that this condition is undoubtedly due to the late rotation of the bowel and descent of the cecum from its hepatic position after the formation of the parietal portion of the peritoneal cavity in the infant. The cecum burrows its way into position, as it were, through the peritoneum. Such cases, however, are often found to show the bands of adhesions and narrowing of the ileum.

During the past two years we have observed many cases in which there was a definite kink of the ileum within a few inches of its termination. The ileum was rolled over and fixed upon the mesentery, evidently a condition of inflammatory origin. Sometimes these adhesions, with resulting bands of peritoneum causing a kink, appear to be a congenital development, because the condition has been reported as existing in children without evidence of local inflammatory cause. It has been observed that when adhesions were present, or the peritoneal bands were greatly thickened, the appendix also showed chronic inflammation which was apparently the source of the peritoneal thickening. The relief afforded by freeing the bowel of the adhesions indicates that this is undoubtedly a condition which has much to do with the ill health of the individual, even though the greater number of symptoms were not local but reflex in character, acting upon the stomach and intestines (Fig. 131).

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* Jackson: "Trans. Western Surg. and Gyn. Assoc.," 1908.

With the development of technic in surgery the risks of operation have gradually been eliminated, and considerations other than that of mortality have become of marked importance, viz., morbidity and permanent cure. Some twenty years ago surgery of the appendix was confined to the treatment of grave and tangible lesions, such as draining abscesses. A little later on the appendix was searched for and removed during operation for abscess, and still later the "interval" operation was developed, which not only

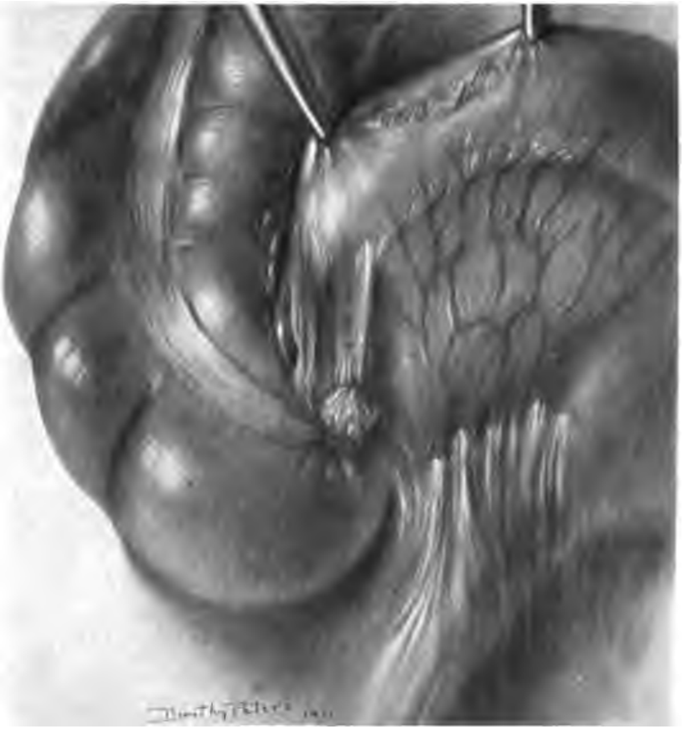

Fig. 131.—Lane kink after separation of the band and removal of the appendix.

prevented serious infection but relieved these patients of the minor symptoms associated with chronic catarrhal appendix. Operations upon the appendix became fixed within narrow limits: they

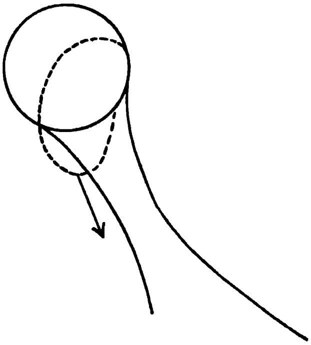

Fig. 132.—Form of narrowing of the ileum in kink (Lane).

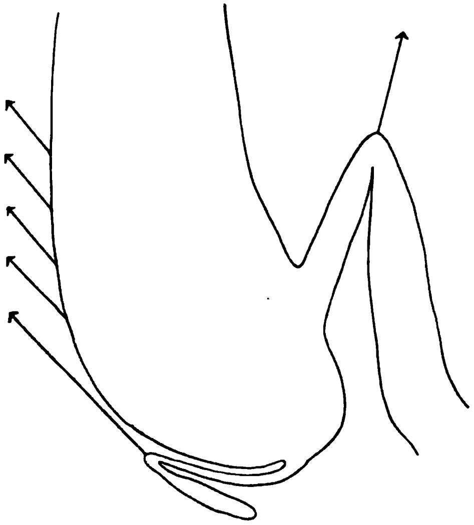

Fig. 133.—Lines of traction with weight in cecum (Lane).

were made through the smallest possible opening in the shortest possible time, with the least possible exposure of the intestine, and with no examination of organs other than the appendix. In rare instances the patient's failure to recover might later show that he had gall-stones, ureteral calculi, or even sacroiliac disease in addition to the diseased appendix.

To-day the refinements of surgical methods demand a more careful examination of the abdomen in a larger percentage of operated cases, especially in those individuals who do not present well-marked clinical symptoms of the disease which is suspected. The object of this brief paper is the earnest recommendation that the terminal 4 inches of the ileum be examined in all cases where it is convenient to do so when the abdomen is open, and especially should this be done when the condition of the appendix at operation (seen through a small incision) does not show sufficient changes to account for the serious symptoms which demanded operative procedures.

It is not always possible to differentiate, clinically, the symptoms under consideration from those caused by disease of the appendix, as the conditions are so often associated. The region of the kink is usually tender—extending from the umbilicus downward to the right, while a history of localized pain may also be obtained. The pain is increased by peristaltic activity, especially when caused by the activity of the individual. The intestinal and gastric symptoms are often more marked at fairly regular periods after eating, and frequently there is a distention of the small intestine in evidence when the individual is fatigued. In some of these cases with the symptoms outlined as above, there is chronic constipation, and also alternating constipation and colitis (Figs. 132 and 133).

In the treatment it is essential to cut all confining bands, and to prevent the formation of adhesions by adjusting the peritoneum with sutures. In some cases the application of sterile vaselin over the traumaticized peritoneal area seems to prevent the development of deleterious adhesions following the operation.

THE DYSPEPTIC TYPE OF CHRONIC APPENDICITIS (PYLORIC SPASM), WITH DIFFERENTIAL DIAGNOSIS*

By CHRISTOPHER GRAHAM and DONALD GUTHRIE

General Considerations.—Cases of chronic appendicitis in which the stomach symptoms predominate have been a stumbling-block in the past to both clinician and surgeon, and to-day the symptomatology of the condition is far from being definitely settled. In the early days many of these cases were operated on by surgeons in general for ulcer of the stomach, and while no lesion was found in the stomach, a needless gastro-enterostomy was performed for the so-called medical ulcer, which operation brought the patient trouble rather than relief. In our earlier experience we frequently were at fault. These patients were made worse by the first operation, and had bile regurgitation added to their former distress, necessitating a second operation for their relief.

It has long been noted that chronic dyspepsia has been cured in patients who for years have been treated for chronic stomach disorders, in whom an acute appendicitis necessitated operation. This attack at the time was thought to have been a separate trouble. Indeed the medical profession has been slow in grasping the point that the stomach picture was due to chronic appendicitis.

In the last few years the French have written extensively on dyspeptic appendicitis, and in this country the earlier writings gave chronic dyspepsia and intestinal intoxications as etiologic factors of appendicitis. Murphy, Ochsner, Richardson, Deaver, Eggleston and many others in their later writings have recognized the part played by the appendix and gall-bladder in causing chronic digestive disturbances, and have made many valuable contributions to the subject.

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* Reprinted from "Jour. Am. Med. Assoc.," March 19, 1910, vol. liv, pp. 96–963.

In our effort to work out a symptomatology of this condition we have reviewed carefully the histories of some 200 patients, and compared them with the histories of ulcer of the stomach and duodenum and gall-bladder disease. Of these 200 patients, 115 have been operated upon for a year or more. A letter has been written to each patient and the exact condition of health ascertained.

Differential Diagnosis.- Chronic indigestion is most typically exemplified in chronic peptic ulcer, gall-bladder pathology, appendicitis, and cancer of the stomach, but we should hold clearly in mind the indigestion of pancreatitis, tuberculosis (especially pulmonary), tuberculous lesions of the ileocecal region, Bright's disease, and pernicious anemia. This latter class of sufferers often present themselves solely because of digestive disturbances, and not infrequently it calls for painstaking care to reach a correct diagnosis.

1. Ulcer.- Chronic ulcer of the stomach and duodenum has a definite, clear-cut, and regular symptomatology, and we shall discuss this as the purest type of "indigestion." First, let us note that the histories of those who come to operation cover years of complaint, and that for much of the time the periods of attack and periods of freedom from symptoms alternate. Early in the history of this complaint the appetite remains good, nutrition does not fail, and food brings immediate relief from all symptoms; the pain, distress, gas, sour eructations, nausea or vomiting returning one to four hours after meals. The heartier the meal, the more marked and prolonged the relief. During the period of attack this precise relief of symptoms by food or drink and regular return one to four hours later is peculiarly characteristic, and this prevails until complications have arisen that seriously interfere with the gastric function. Another stage of the trouble may be considered to begin after many periods of attack. The peculiar type remains unchanged. The attacks are more severe and prolonged, appetite may fail, or food is not taken because of pain, distress, gas, vomiting, sour eructations, and burning stomach. Food and drink relieve, but the time of relief is shortened and the later pain increased. Vomiting may replace eructations, and gives relief, as does irrigation of the stomach. Nutrition decreases not so often because of lessened appetite or of prescribed diet as because of fear of later distressing symptoms. Relief for a time comes from food or drinks, vomiting, irrigation, and alkalies, but the distress returns again when the acid, acrid condition of the stomach-contents returns. It is not the chronicity or the periodicity that is peculiar, nor the degree or location of the pain, nor the vomiting, gas, sour eructations, or sour burning stomach; these are common to all types of chronic dyspeptic trouble—gall-stones, appendicitis, cancer, etc.; the characteristic point is the time the pain appears, with its accompanying symptoms of vomiting, gas, and sour eructations; its regularity after meals or after other measures that quiet, and the equally ready control of symptoms by food, vomiting, irrigation, etc. This characteristic regularity day after day, meal after meal, during the period of attack is hardly equaled in any other lesion or functional disorder. Later, when complications have appeared, the symptoms change. Food may not ease, but rather increase the distress, which is often more or less continuous. There are no periods of real relief; vomiting is perhaps less frequent, is more copious, and gives only partial relief; appetite and nutrition fail.

II. Gall-bladder Diseases.—Gall-bladder disease has its peculiar type of digestive disturbances. We distinguish four stages, based on the degree of severity of symptoms developed in the history:

1. Those patients with mild disturbance, usually gastric, and often lightly considered by the patients and even more lightly by the physicians. These are light attacks of distress, gas, upward pressure, coming often soon after food, or at irregular times, often of sudden onset and short duration, eased by belching, slight vomiting, or regurgitation, or slipping away almost unnoticed and without treatment, though various measures may get credit for their relief. These sudden, irregular, mild dyspeptic attacks are

quite as typical of gall-bladder disturbance as are the severe typical attacks which, as a rule, supplant the mild.

2. There is another class of patients with more or less prolonged, dull (mild or severe) pain in the epigastric area, right hypochondrium, or whole liver area. This pain may be increased by food, exertion, or motion; deep respiration gives pain, and when located posteriorly the trouble may be called pleurisy. These patients pass through prolonged, steady attacks, their distress may alternate with ease, and comparatively good or excellent health may be enjoyed for a time. During an attack dyspeptic symptoms are prone to be present, and but for the irregularity, as compared with ulcer, one might oftenest consider gastric lesions.

3. In the third class is to be found the great number in whom the correct diagnosis is made, and in this class surgery finds its greatest activity. Here we have the so-called typical gall-stone attack—sudden, severe epigastric pain, radiating to the right costal arch (at times to left), through to the back or scapular region, spasm of the diaphragm, upward pressure, gas, nausea, vomiting, and after a longer or shorter terrific attack comes sudden cessation and, until complications occur, almost immediate return to health. Sudden onset, and sudden cessation without apparent cause or without treatment, are quite peculiar to gall-stone disease when no complications are present. These attacks come irregularly, night or day, and oftenest bear no relation to food, though often called acute indigestion, gastralgia, neuralgic stomach, and other equally incorrect names.

4. The fourth condition is that of chronic gall-bladder trouble—adhesions, duct obstruction, perforation, contractions, and duct infections—with pancreatitis. Often in this class chronic gastric disturbances predominate, and the picture is so closely related to chronic ulcer with complications that a differential diagnosis cannot be clearly made if only present symptoms are considered. A correct diagnosis depends on the development of the early history. However, the chief end is obtained when the necessity for surgery is realized, and the patient is sent for relief with a diagnosis of a surgical abdominal trouble.

III. Chronic Appendicitis.—In reviewing our histories of chronic appendicitis in which stomach symptoms predominate, we find that there is a neurotic element running through many of the cases. Whether this is an inherited taint or due to the chronic disability we do not know. Sex plays no important part. The average age is less than in either chronic ulcer or gall-bladder sufferers. In the former it is forty-five, in the latter forty, and in chronic appendicitis thirty-four years.

Character of Attacks.—We note in general that the symptoms are irregular when compared with chronic peptic ulcer; prolonged when compared with gall-bladder trouble; the exceptions being, ulcer with complications, gall-stones with duct obstruction, and infection. If the attacks of chronic appendicitis be short, they lack the regularity of ulcer, are usually more severe, unless perforative ulcer be considered. When studied with gall-stones, there may be less distinction, but the characteristic radiation of the pain of gall-stones is wanting, and the clear-cut gall-stone attack is poorly simulated. The whole syndrome is attributed to food intake directly more often than in ulcer, and still more frequently than in gall-bladder disturbances.

Exertion is a factor often laid at the door of appendiceal attacks; rarely is this true in peptic ulcers and gall-stones. Then, too, absolute disability, so that the bed is sought, is common during an appendiceal course, and is rare in ulcers, except bad hemorrhages, perforations, and other late complications, when nutrition suffers greatly. In gall-stones the bed is seldom taken to except at the crisis, or in common-duct obstruction, infection, or severe pancreatitis, and even then, as a rule, we find our patients about. We note the chronicity and the periodicity in all, but chronic appendicitis lacks the regular relief to all symptoms on taking food, and the regular return of pain in one to four hours. In chronic appendicitis the food, instead of bringing ease, produces early if not immediate discomfort; one meal giving one effect, the next meal quite another. Rarely do meals give ease in appendicitis, except in some hyperacid conditions, and in this relief there is no regularity meal by meal or day by day, as in ulcer. When we turn to gall-stones, there are the short, clear-cut attacks with sudden onset and sudden relief, mild or severe, with the severer cases giving typical radiation, and, when relief comes, perfect health instead of a few or many days of general disability.

Pain.—Pain in chronic appendicitis is the great prevailing symptom, and is often manifested by a queer distress. It does not seem so often to reach the severity it does in gall-stones, but is more prolonged; neither does it so often reach the constancy and intensity during the whole attack that it does in decided cases of chronic ulcer. However, it is not the kind, the degree, the location, or the radiation, nor is the time of the pain so great a factor as it is in ulcer. The time of the pain is irregular. During an attack pain oftenest appears soon after, or is caused directly by, food, save in those rather rare instances of highly acid condition, or when, from fear of food light diet has heightened the appetite, at which time food gives short respite. Often there is present rather continuous pain or rather a continuous distress which is epigastric, or so indefinitely abdominal that the patient describes it as epigastric, when really it is abdominal. There is not the clear-cut repetition and definite pain of ulcer, nor the clear-cut definite gall-bladder attacks; neither is there so often the definite location of the pain. Nausea, distress, flatulence, and a feeling of distention cover the sensations of far more patients with chronic appendicitis than of chronic peptic ulcer or gall-bladder disease. The degree and the kind of pain are not specific, but have a bearing. Severe pain points to acute appendicitis, which we are not considering here.

Location.—Location of pain has a bearing, though we may have only epigastric pain complained of in any or all three conditions. In gastric ulcer the pain is purely epigastric, except in perforation, great dilatation, and prolapse conditions. In gall-stones it is epigastric, with radiation to right and to back, or a sore and tender feeling in any part of the liver area. In chronic appendicitis it may be epigastric only, but often indefinitely epigastric and abdominal, in low gall-bladder or high appendix area. Then the radiation is usually *nil* in ulcer, to right costal arch and back in gall-bladder, indefinitely or plainly abdominal in chronic appendicitis.

With attacks of dyspepsia with epigastric pain, with radiation to or about the umbilicus or lower abdomen, hold first and clearly to appendiceal disturbance, keeping in mind peptic ulcer and gall-bladder trouble with possible complications. A tender area is often found at McBurney's point when not at all complained of subjectively.

Control of Symptoms.—When we come to control of symptoms, we find a clear-cut difference. Food, drink, alkalies, and irrigation bring more or less complete and immediate relief in uncomplicated peptic ulcer, the symptoms returning regularly within a few hours at most.

In chronic appendicitis anything taken into the stomach usually disturbs, and only rarely brings relief, and if some ease is felt, it is not regular and complete. Vomiting may bring relief in chronic appendicitis, but rarely so completely as in ulcer, and vomiting is much less constant in chronic appendicitis, and hence is less a factor.

In the usual run of uncomplicated gall-stone diseases food does not give much evidence of being a direct cause of the painful attacks.

Early History.—Before leaving the subject of pain we would call attention to attacks in childhood or early youth of diarrhea or "stomach-ache," more commonly termed "belly-ache," as these attacks are usually abdominal. The attacks, the histories of which are often clearly recited, are typical appendicitis, and are the logical forerunners of the later dyspeptic attack. Then, too, recall the history of years of indefinite dyspeptic symptoms, followed by a typical appendiceal attack, with operation and the cure of the dyspepsia. Let us not forget that in any abdominal attack with prominent gastric symptoms, where a history of pain about the umbilicus or lower abdomen is definite, we should hold first and clearly to appendiceal trouble, not forgetting gall-stones, ulcer, pelvic tumors (ectopic pregnancy), and perhaps general constitutional disease—Bright's disease, tuberculosis, etc.

Vomiting.—Vomiting in ulcer is usually regular (except in complications), one to four hours after meals when all symptoms are at their height. It is sour, acrid, bitter-burning liquid, perhaps with some food. Ease follows the vomiting, and the vomiting is allayed by food taken, as are all other distressing symptoms. In gall-bladder cases the vomiting is only at the crisis, and is a bitter, acrid mucus, unless by chance the spasm follows closely the ingestion of food. In chronic appendicitis vomiting is not so prominent a symptom as in ulcer and does afford a marked degree of relief. It is irregular during the attack, but when it does appear it closely follows food, and consists of food rather than sour liquid, though both may be present. Nausea rather than vomiting is a characteristic.

Gas.—In chronic appendicitis discomfort from gas makes up more the general complaint than it does in ulcer. There is abdominal distention of gas scarcely located by the patient. Gas is belched, but not so much as in ulcer, and there is not the intense feeling of gas distention that is experienced at the height of a gall-bladder attack. The amount of sour eructations is not so great as in ulcer. In chronic appendicitis the patient is conscious of a feeling of slipping of gas in the bowels, and its passage gives a peculiar sense of relief, as at times do bowel movements. In this rather quiet and general way gas aids in the diagnosis.

Bowels.—Constipation is one of the early symptoms of appendicitis, and may be the only one for a considerable period. It is usually marked, though spells of diarrhea occur and usher in an attack. Free movements give considerable ease. Mucus is present though not distinctive.

Appetite.—In chronic appendicitis the appetite often fails, or it is so variable that this helps in distinguishing appendicitis from ulcer. At other times food is refused because of immediate distress, and when both factors are in action, nutrition suffers. In ulcer the appetite rarely fails, except late, and if food is refused, it is because of the pain, distress, and vomiting that follow one to four hours later. Nutrition therefore usually suffers along the whole course of chronic appendicitis as a result of the diminished appetite or lessened intake of food, because of the immediate distress which follows. If nutrition suffers in early ulcer, it is because of vomiting or due to diet to avoid late distressing symptoms. Nutrition rarely fails in gall-stones until pancreatitis or complications supervene.

Test-meal.—The test-meal is of value in the diagnosis because it is so negative. In a paper* on "The Value of the Test Meal in Gastric Diagnosis" we called attention to this fact. There are no food remnants in the meal, hence no obstruction, and this is evidence of value. The stomach is usually normal in size and position and the acids oftenest within the normal limits, though in some cases they may be high. No organic acids, no bacteria or blood, as a rule, are present.

Treatment.—Treatment in chronic appendicitis will scarcely bear discussion. In ulcer of the stomach we do have medical cases in greater number than surgical cases. In gall-bladder diseases we may be pardoned for advising some sufferers to take the Carlsbad cure or other methods of treatment that may influence the oncoming of the later stage, but chronic appendicitis can only justly fall to surgery, and any other advice when the diagnosis is made must be considered faulty and perhaps dangerous. However, we cannot meet all cases clearly with only gastric symptoms present—pain, vomiting, gas, etc. If no history is recalled of pain radiating to the right costal arch or back, or if no general liver pain can be elicited, with no history of sudden, short, mild, or severe epigastric attacks, with abrupt cessation and perfect health immediately following, we cannot say gall-stones. If with these same symptoms of pain, gas, and vomiting, and with the same epigastric location, we can get no early history of periods of attack with regular symptoms one to four hours after food, with clear cessation of symptoms following food, drinks, etc., but only symptoms of chronic complicated ulcer, then we cannot decide. So also with the same signs if we can get no history of childhood or youthful attacks of diarrhea or "belly-ache," no radiation of pain to the umbilicus or lower abdomen, no tenderness at McBurney's point, or other local manifestations, but only chronic gastric symptoms, then we cannot diagnose undoubted appendicitis. What we can say is, "You have a serious trouble, perhaps in the upper abdomen, and surgery affords the great chance of relief," and it should be accepted. If at operation the surgeon finds the upper abdomen normal, let him next look to the great likely point, the appendix. This holds out many promises of relief.

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* "New York Med. Jour.," Sept. 4, 1909.

Summary of Cases.—Of the patients, 58 were females, 57 males. The average age was thirty-four years and the average duration seven and one-half years.

All patients have regained normal weight; many are above previously normal weight; none has lost weight.

Condition	Number of Cases.	Per Cent.
Cured; no symptoms	89	77.4
Very much improved	7	6.0
Improved: some occasional return of symptoms	13	11.3
No improvement	6	5.2
Total	115	

Condition of the appendix found at operation, classified pathologically:

	Number of Cases
Chronic appendicitis with fecaliths	58
Chronic adherent appendices	20
Chronic appendicitis	14
Chronic obliterating appendices	8
Chronic appendicitis, cystic tip	6
Subacute appendicitis	6
Carcinoma of appendix	1
Tuberculosis of appendix	1
Acute appendicitis	1
Total	115

CLASSIFICATION OF APPENDICITIS; RELATION OF CHRONIC APPENDICITIS TO OBLITERATION OF THE LUMEN, CARCINOMA, AND DISTURBANCES IN THE GASTRO-HEPATICO-DUODENO-PANCREATIC PHYSIOLOGIC SYSTEM*

By WILLIAM CARPENTER MacCARTY

The enormous amount of literature and the unsatisfactory discussions which have been evoked by the appendix, the numerous and varied classifications of inflammation in this anatomic vestige, the attempt to fit pathologic classifications of the subject to the clinical groups of cases, and the varying opinions as to whether or not obliteration occurs as a physiologic involution or as the result of inflammatory reaction, and whether or not there is any etiologic relationship between the appendix and conditions in the stomach, duodenum, and bile-passages, have been the stimuli for this extensive investigation of such a common subject.

The object was not to combat any pathologic or clinical classification of the condition or theory of obliteration, but to confirm or disprove; to consider the subject in such a manner that the clinician and pathologist might better understand each other, and to bring to both a more intimate consideration of processes in nature rather than dogmatic ideas of pathology and clinical medicine.

The material consists of the appendices removed by W. J. and

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* Read in the Section on Pathology and Physiology of the American Medical Association, at the Sixty-first Annual Session, held at St. Louis, June, 1910. A report on the pathologic examination of 5,000 specimens with a comparative study of the pathology and the clinical histories in 2,000 cases. The monograph of which this is an abstract will appear later. (Reprinted from "Jour. Am. Med. Assoc.," Aug. 6, 1910, vol. lv, pp. 488–491.)

C. H. Mayo and E. S. Judd and E. H. Beckman in St. Mary's Hospital. The cases were taken in order of removal during the years 1906, 1907, 1908, and 1909. They were studied in three groups, namely: (1) appendices removed for appendicitis alone, (2) appendices removed during operation for other conditions in the abdomen, and (3) appendices removed from patients operated on for cholecystitis and cholelithiasis.

In only 2,000 of the cases were the histories examined and compared with the pathologic findings. Of these, 1,005 specimens were removed for appendicitis alone and 995 in conjunction with other conditions, such as fibroids of the uterus, carcinoma of the uterus, ovarian cysts, retroverted uteri, hernia, cholecystitis, "pyloric spasm," duodenal and gastric ulcers, etc.

In 5,000 cases, including the 2,000 with the histories, the specimens were examined especially with the idea of studying the reaction to infection of an organ which varies so broadly anatomically and is exposed to such a great variety of pathogenic organisms. During this examination notes, diagrams, and photographs were made of the general inflammatory pictures found and the occurrence of obliteration, carcinoma, diverticula, and foreign bodies.

The specimens, which had been preserved in 3.7 per cent. formaldehyd solution, were cut in gross series, the blocks ranging from 2 mm. to 4 mm. in thickness. The series was made from the tip to the base and each layer of the wall was studied grossly. All cases not showing definite gross lesions were examined microscopically by means of frozen and celloidin sections.

Obliteration of Lumen.—The examination of this series of cases has shown that obliteration* of the lumen of the appendix may begin as early as the fifth year of life and be complete at the tenth year of life. The wide variation in the age during which the process of obliteration occurs may be seen from these facts, and that at the age of sixty-seven the tip alone may be obliterated. Ribbert,† who has been the chief exponent of the physiologic involution-idea of the process of obliteration and the authority most commonly quoted, found that the percentage of obliterated appendices increased with the increase of the decades. This observation was made on autopsy material, and is correct when one considers all stages of obliteration, including complete obliteration. From this standpoint his observations are confirmed by this series. The error, however, into which he and others have fallen is in taking all cases, partial and complete. It is impossible to determine at what age the process ceased to act in an appendix the lumen of which is completely obliterated, because the individual may have carried it completely obliterated since the age of ten years. Therefore it is only fair to consider cases in which the process of obliteration is not complete. If this is done, it will be seen that the process does not increase gradually with the decades.

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* In describing total obliteration of the lumen of the appendix in this paper it must be considered that a small part of the appendix was inverted at operation, and that "total" means the whole specimen in the laboratory.

† Ribbert: "Virchow's Arch. f. path. Anat.," cxxxii, 66.

TABLE SHOWING PERCENTAGE OF APPENDICES WITH PARTIALLY OR COMPLETELY OBLITERATED LUMINA AT VARIOUS AGES

Age	Ribbert	MacCarty	
	Partial and Complete Percentage	Complete Percentage	Partia Percentage
1–10 years..................	4	0	11
10–20 years..................	11	3	17
20–30 years..................	17	8	16
30–40 years..................	25	15	22
40–50 years..................	27	16	17
50–60 years..................	36	17	21
60–70 years..................	53	50	50
70–80 years..................	58	0	0

The variation in the percentage of partially obliterated cases is greatest between the fifth year and the fortieth year. The percentage then decreases and rises again to the seventieth year. The same sudden rise is seen when one examines the totally obliterated specimens, but the percentages between the fifth and fortieth years gradually increase instead of decrease. This seems to me to be strong evidence which may be added to the histologic picture of inflammation in obliteration.

The time at which the examination of the appendix is made greatly modifies the conception of the age at which obliteration occurs. The average age at which the tip is found to be obliterated in cases of appendicitis is 29.8 years, and the average in the appendices which were removed at the time of operation for cholecystitis is 39.1 years. This is a wide variation and is parallel with the average ages at which operations for appendicitis and cholecystitis occur, namely, respectively 25.5 years and 39.9 years.

An examination of the average ages at which the different degrees of obliteration occur shows that the average ages of the increasing amounts of obliteration increases gradually from 29.8 years—which is the average age for tip obliteration—to 34.6 years, which is the average age for total obliteration. The difference of four years between these two gives the approximate duration of the process of obliteration. This is exceedingly short for a natural physiologic involutionary process, especially when one considers that it may occur at a very early age, and at any time from five years to old age.

It is fair, from these figures and others which time does not permit giving, to state that the process of obliteration is not a physiologic involution which begins at the tip and gradually involves the entire appendix, but a pathologic process, resulting from chronic inflammation.

Carcinoma.—The occurrence of carcinoma in such a large series is of interest. During this examination 22 cases of carcinoma were found. In 17 of the specimens (77 per cent.) the diagnosis was not possible from the external appearance. In one of the 17 the growth had made its way through to the serosa and was visible as a small orange-colored speck about 0.5 mm. in diameter. This on gross external examination was thought to be fat in the subserosa. Microscopic examination revealed it to be carcinoma which had reached this point through the lymphatics.

In none of the 17 specimens was there any definite enlargement to indicate the presence of a neoplasm.

Ninety per cent. occurred in partially obliterated appendices, and all were associated with marked chronic inflammation.

The growth itself on gross section appears as an orange-colored, homogeneous or finely granular mass occupying the center of the section, a quadrant or all of the coats excepting the muscularis, subserosa, and serosa.

The color is characteristic in specimens preserved in formaldehyd solution. In all cases there was the same orange color. This is very important in distinguishing the neoplasm from lemon-yellow fat, which occurs in the submucosa and subserosa, especially in chronically inflamed or obliterated specimens.

Microscopically the growth consists of alveoli filled with epithelial cells, the nuclei of which are in general oval or round and present fewer irregularities than one usually sees in carcinoma in other portions of the alimentary canal. The size and lack of marked irregularity on the part of the nuclei, as well as the alveolar arrangement and staining quality, have been the cause of some observers calling the neoplasms endotheliomata and basal-cell carcinomata.

If one, however, examines with the high power the nuclei of remaining glands in appendices the lumina of which are being obliterated, it will be seen that there are gradations from simple hyperplasia to carcinoma.

There was nothing in the clinical histories to suggest carcinoma; in fact, one specimen was found accidentally in a man aged eighty years, who died after removal of a stone from the bladder.

Carcinoma occurred in this series as early as five years and as late as eighty years. Thirty-one per cent. of the carcinomata were found in appendices removed in association with other abdominal conditions. It occurred in females in 73 per cent. The longest duration of the symptom was fifteen years and the shortest duration was three weeks.

In the first 2,000 specimens examined it occurred in 2.2 per cent. of the partially or completely obliterated appendices and in 0.6 per cent. of all appendices.

In the complete series of 5,000 specimens it occurred in 1.6 per cent. of partially or completely obliterated appendices and in 0.44 per cent. of all specimens.

Diverticula.—Diverticula of the appendix occurred, usually as a multiple condition, in seventeen cases. They are grossly visible, but vary greatly in size, the largest in the series being about 0.5 cm. in diameter and projecting beyond the surface about 0.5 cm. They are covered by serosa and vary in color according to their contents. They consist of an evagination of the submucosa, muscularis mucosæ, and mucosa through a hole in the muscular coats. The edges of this hole are rounded off and permit the tissue of the submucosa, which fuses with the subserosa, to pass around it in a well-defined manner. The wall of the diverticula consists only of the mucosa, muscularis mucosæ, submucosa, subserosa, and serosa. These coats are thinner than normal.

The condition was found in a wide range of ages, the eldest sixty-four years and the youngest eighteen years.

Fifty-six per cent. of the cases occurred in acute appendicitis; 56 per cent. occurred in females. The only cases that were found in association with other conditions were removed with gall-stones. Of these there were two, or 12 per cent. of the cases, which occurred with gall-stones. In one of these the appendicitis was subacute and in the other acute. The average duration of the symptoms was seven years and the average age at operation was thirty-four years. None of these patients gave a history of jaundice. Two complained of pain in the epigastrium and one in the right hypochondrium. The condition does not seem to bring about symptoms as early in life as appendicitis ordinarily does, but a higher percentage seem to be acute.

In regard to the question which has been raised in studies made by me on gastric ulcer* and cholecystitis,† that is, whether or not there is any etiologic relationship between the chronic inflammatory process in the appendix and disturbances in the stomach, duodenum, and bile-passages, the following observations are of interest:

In the previous studies it was found that 23.2 per cent. of 365 cases in which cholecystectomy was performed showed symptoms which began at or under twenty-five years of age, and that 13 per cent. of the cases gave definite histories of pain or soreness in the region of the appendix. In 59 of these cases of cholecystitis the appendices were removed and 69 per cent. showed undoubted gross or microscopic evidence of inflammation varying from a chronic catarrhal condition to complete obliteration and periappendicitis.

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* MacCarty: "Surg., Gynec. and Obst.," May, 1910.

† MacCarty: "Ann. Surg.," May, 1910.

In the present report of cases 52 per cent. of 175 cases of cholecystitis with or without stones gave histories of pain in the region of the appendix.

In 1,147 histories which include all the cases of appendicitis and appendices removed during operation for conditions other than cholecystitis with or without stones, there was a history of pain in the epigastrium or right hypochondrium in 13 per cent. In 9.4 per cent. there was pain in the abdomen and in 14.6 per cent. pain in the abdomen which radiated to and became localized in the appendix region.

A consideration of the average duration from the onset of symptoms to operation in appendicitis, cholecystitis, and cholelithiasis reveals respectively 2 years, 4.9 years, and 6.5 years. It may be seen that the average duration in cases of cholecystitis lies between the average in appendicitis and cholelithiasis.

The questions arise: Is this a mere coincidence, especially when we know that simple cholecystitis precedes gall-stones? Is there any relationship between these conditions? Are we dealing with a process which manifests itself in three stages, namely, appendicitis, simple cholecystitis, and cholecystitis with stones?

The average age of patients at onset of the symptoms in these three conditions is also of interest, although there is not the same parallel. In appendicitis it is 23.5 years, in cholecystitis 34.7 years, while in cholelithiasis it is 33.8 years. There is one thing to be considered, however, and that is the fact that the symptoms in cholelithiasis are likely to be very much more sudden and severe and therefore demand earlier attention than in simple cholecystitis.

There is a very marked contrast between the percentage of appendices with partially or completely obliterated lumina at autopsy and at operation for appendicitis and that of appendices which have been removed in association with cholecystitis and cholelithiasis: 23.5 per cent. at operation; 12 per cent. (Nowicki), 16.6 per cent. (Toft), 25 per cent. (Ribbert), 14 per cent. (Zuckerkandl), 22.6 per cent. (Sudsuki), 20 per cent. (Sprengel), 11 per cent. (Ciechanowski and Gliniski)* at autopsy, and 52 per cent. in association with inflammatory conditions in the gall-bladder have partially or completely obliterated lumina.

Eight and seven-tenths per cent. of 2,000 appendices were associated with cholecystitis.

In spite of the fact that the male patients operated on for appendicitis formed a higher percentage than did the females (55.5 per cent. males and 44.5 per cent. females), partial obliteration of the lumen occurred more often in females (55.2 per cent. females and 44.8 per cent. males). This may be one of the coincidences which lead to false deductions in all statistics, but the figures are sufficiently significant to keep in mind as possible evidence of the probable fact that the inflammatory process in the appendix causes disturbances in the bile-passages directly or indirectly, and may have some relation to the fact that cholecystitis is decidedly more frequent in females than in males.

Foreign bodies and hard fecaliths occurred in 57 specimens in the complete series. The foreign bodies consisted of short hairs, tooth-brush bristles, shot, gall-stones, fruit-seeds, pins, and worms.

Classification.—An examination of the literature on the subject of appendicitis reveals a great variety of classifications of the condition. Many of these are based on pathology and clinical histories; some have been made by the clinician, some by the surgeon, and some by the pathologist. In the literature these have been used indiscriminately to describe clinical, surgical, and pathologic pictures, resulting in a confusion of ideas of the condition, especially on the part of the clinician and surgeon.

Intimacy with a large series of cases clinically, surgically, and pathologically brings about a conception of appendicitis which is devoid of sharp clinical, surgical, and pathologic entities. The conditions are apparently the results of a process dependent on the peculiar structure of an anatomic vestige, its precarious situation, and exposure to many pathogenic organisms and trauma.

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* MacCarty: "Virchow's Arch. f. path. Anat.," 1906, cixxxv, 504; Nowicki: "Virchow's Arch. f. path. Anat.," cxcv, 197.

The results of these and perhaps other obscurer and less defined etiologic factors group themselves according to the point of view. To the clinician who sees only the exterior of his patient and studies the reaction of the whole organism to the local condition from the standpoint of fever, chills, pain, nausea, vomiting, and onset of the symptoms, the condition is one which confines itself either definitely to the appendix or to possibilities of which the appendix is but one. If confined to the appendix, four conditions are possible, namely, acute, chronic, and subacute appendicitis or periappendicitis, the latter being the result of one or more of the other three.

To the surgeon, who is interested in the real pathologic condition secondarily to his immediate mission, the removal of a condition detrimental to life, the appendix on exposure may reveal its exact pathology on a careful study of its exterior. To him the most important conditions in their order of importance are: acute periappendicitis, peritonitis, acute appendicitis, chronic periappendicitis, subacute appendicitis, chronic catarrhal appendicitis, complete or partial obliteration, and carcinoma.

To the pathologist the classification of the conditions found is similar to that made for the surgeon, but includes the acute catarrhal condition, which is rarely if ever seen in the strictest sense. It is difficult to obtain a specimen in which the term "acute catarrhal" can be correctly used unless the term be extended beyond its real meaning and be allowed to include the extension of the process in the mucosa to the underlying submucosa, lymph-follicles, and even through the lymphatics to the subserosa. The extension of the condition is so rapid when the process in the mucosa is acute that it is difficult to conceive of it being confined to the mucosa, which the name signifies.

It may be well, however, since the term has become so well established in our nomenclature, to continue its usage, with the modification that although the process has its origin in the mucosa, the submucosa and follicles share very early in the reaction. Indeed, the serosa may be congested without the wall showing enough leukocytes to cause the condition to be called purulent or necrotic.

With this broad idea of the term catarrhal the specimens in this series group themselves under the following terms:*

1. *Appendicitis catarrhalis acuta:* A condition in which the mucosa is infiltrated with leukocytes and is congested; there is a reaction in the lymph-follicles and lymphatic tissue of the submucosa. The lymph-spaces or vessels in all the other coats may also contain leukocytes.

2. *Appendicitis catarrhalis chronica:* Arises as a result of repeated mild or severe acute catarrhal conditions and is marked by an increase of scar-tissue and distortion of the normal regularity of the coats and the glands. Blood-pigment is very frequently present in the mucosa.

3. *Appendicitis purulenta necrotica:* An advanced stage of the acute catarrhal condition, plus the formation of intramural abscesses and necrosis.

4. *Periappendicitis acuta:* Merely describes an extension to the peritoneum of the conditions just described. The subserosa and serosa become congested, purulent, or necrotic. The scar-tissue remains of such a condition may be described as *periappendicitis chronica.*

5. *Obliteration:* A condition of the lumen of the appendix which occurs as the result of destruction of the mucosa and formation of scar-tissue in the submucosa and other coats. It occurs in any portion of the lumen.

Conclusions.—1. Of all appendices removed at operation 23.5 per cent. are partially or completely obliterated.

2. The shortest duration of the process of obliteration when it is continuous is less than ten years.

3. The process may be complete at ten years of age.

4. Obliteration does not occur as a physiologic involutionary process, but is dependent on a definite inflammatory reaction.

5. In a series of 2,000 specimens 0.6 per cent., or about 1 in every 175 appendices removed at operation, are malignant.

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* MacCarty: "Virchow's Arch. f. path. Anat.," 1906, clxxxv, 515.

6. In a series of 5,000 specimens 0.44 per cent., or about 1 in every 225 appendices removed at operation, are malignant.

7. In a series of 2,000 specimens 2.2 per cent., or about 1 in every 40 partially or completely obliterated appendices, are malignant.

8. In a series of 5,000 specimens 1.6 per cent., or about 1 in every 53 partially or completely obliterated appendices, are malignant.

9. Carcinoma of the appendix may occur as early as five years of age and as late as eighty years of age.

10. Of the carcinomata of the appendix found in this series 77 per cent. were not capable of being diagnosed from the gross external appearance.

11. All appendices with partially or completely obliterated lumina should be removed during operation for other abdominal conditions when it can be done without materially endangering the life of the patient.

CLINICAL AND PATHOLOGIC SIGNIFICANCE OF OBLITERATION, CARCINOMA, AND DIVERTICULUM OF THE APPENDIX*

DEDUCTIONS FROM AN EXAMINATION OF 5,000 SPECIMENS, WITH A COMPARATIVE STUDY OF THE PATHOLOGY AND CLINICAL HISTORIES IN 2,000 CASES†

By WM. CARPENTER MacCARTY and BERNARD FRANCIS McGRATH

The character and significance of obliteration of the lumen of the appendix have been very much disputed since it was first described. The condition was considered a normal physiologic involution, by which the organ itself was disappearing. This view was based upon the fact that autopsies in general showed that the percentages of obliterated appendices increased gradually with the increasing decades, and that the mucosa at the point of obliteration was covered by epithelium. This conception of the process was held and advocated by Ribbert, Zuckerkandl, and others. There were, however, many investigators who from the beginning of the study of the process believed it to be inflammatory.

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* Read before the Section on Pathology, American Medical Association, June, 1910. (Reprinted from "Surgery, Gynecology and Obstetrics," March, 1911.)

† Technic: All specimens were put immediately into 10 per cent. formalin. After fixation they were sectioned grossly transversely into blocks ranging from 2 mm. to 4 mm. in thickness. Notes were made upon the condition of all the coats, and when there was any doubt as to the diagnosis, either frozen or celloidin sections were made. The total series consisted of 5,000 specimens. The first 2,000 were studied in relation to their histories in three groups: appendices removed for appendicitis alone; appendices removed in association with cholecystitis, cholelithiasis, duodenal and gastric ulcers; and those removed in association with other abdominal pathologic conditions. There were 1,005 for appendicitis alone and 995 in association with other conditions, including cholecystitis, cholelithiasis, duodenal and gastric ulcers. Five thousand specimens were studied in relation to obliteration, carcinoma, diverticulum, inflammation, and foreign bodies. The material was furnished by the clinics of W. J. and C. H. Mayo, and E. S. Judd, St. Mary's Hospital, Rochester, Minnesota.

Ribbert and his followers either have given or are giving up the involution theory of obliteration and favoring that of an inflammatory process. It may be stated that the majority of, if not all, pathologists now consider the process the result of infection.

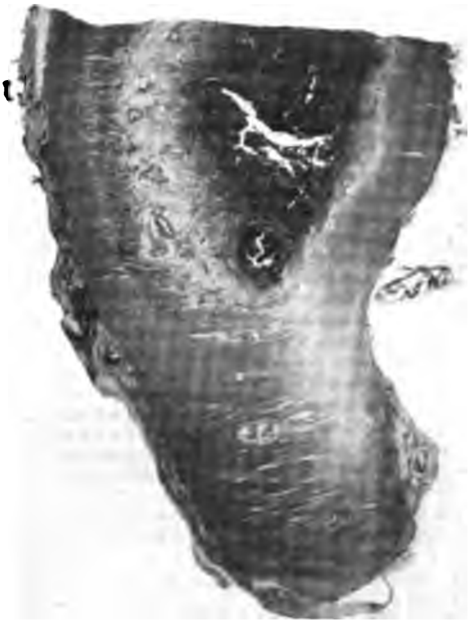

Fig. 134.—(No. 31580.) Section showing the glandless character of the mucosa at the point of greatest activity of the inflammatory process of obliteration.

The occurrence of obliteration in a large series of cases is of interest and importance when considered from the following standpoints:

1. Is obliteration the result of an inflammatory process, or is it a normal physiologic involution?

2. How often does partial or complete obliteration occur at

autopsy in general, operation for appendicitis, and in association with other abdominal pathologic conditions?

3. What are the earliest ages at which obliteration is found to start and to be completed? What are the latest ages?

4. What are the average ages of total* obliteration, and tip obliteration?

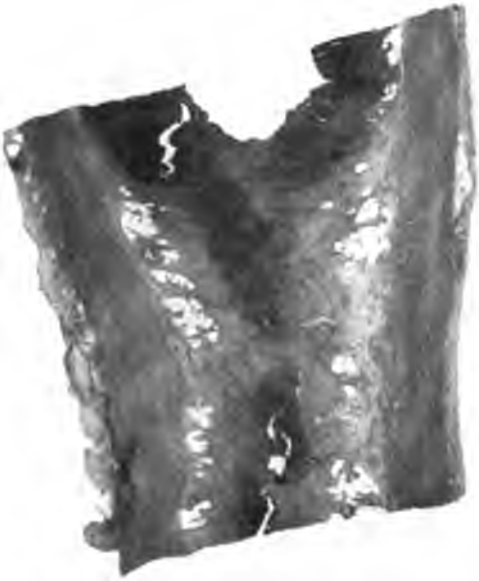

Fig. 135.—(No. 35588.) Section showing the point of activity of the process of obliteration.

5. What influence does the age at the time of examination have upon the conception of the age at which the process occurs?

6. What would be about the duration of the process of obliteration if it were continuous?

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* "Total obliteration" in this article means absence of the lumen in the specimen in the laboratory. On account of the method of removal of the appendix a small portion is left and inverted into the cecum.

7. How often does carcinoma of the appendix occur?

8. What is the relation of obliteration to carcinoma?

9. At what point in the appendix is carcinoma most common?

10. What is the clinical significance of the occurrence of carcinoma and obliteration?

11. How often may death from carcinoma of the appendix be prevented by the surgeon?

12. How often do diverticula of the appendix occur, and what is their clinical significance?

13. How often do foreign bodies occur in the appendix and what is the clinical significance?

OBLITERATION

The process of obliteration of the lumen of the appendix occurs during all ages, from five years to old age. Its activity is greatest between birth and forty years of age, and the average age at which the lumen is found to be completely obliterated is 34.6 years in appendices removed for appendicitis, and 39.1 years in appendices removed during operation for cholecystitis.

The average age at which the tip was found to be obliterated is 29.8 years in cases in which the appendices were removed for appendicitis, and 39.1 years for appendices removed during operation for gall-stones.

For appendices removed with other abdominal conditions, the average stands between these figures, the tip 32.5 years and the total lumen 37.6 years.

From those figures and the fact that the tip may be obliterated at five years of age and the total lumen completely obliterated at ten years of age, it may be seen that the process when acting rapidly extends over a period of about five years, or at least less than ten years. (See Table IX.)

We are dealing with a process, therefore, which may run its course in a comparatively short time and which completes its average course before forty years of age, which is exceedingly short, irregular, and early for a physiologic elimination of a structure which apparently is never eliminated in man.

These results, added to the fact that the point of obliteration bears definite evidence of inflammation, such as distortion of the glands, infiltration of the mucosa, submucosa, and lymph-vessels with lymphocytes, plus distortion of the musculature by scar tissue, are sufficient evidence for an inflammatory process as an etiologic factor rather than physiologic involution. The point at which the lumen is obliterated may be completely covered by epithelium, but in such cases the epithelium is rarely thrown into folds to form definite glands.

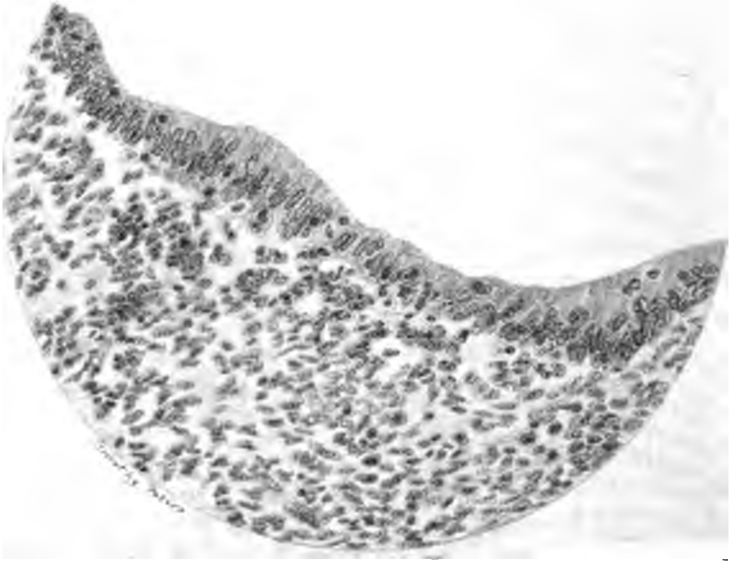


Fig. 136.—(No. 35583.) Epithelium covering the surface of the mucosa at the point of obliteration.

The fact that there is an epithelial covering for the distorted mucosa is no evidence against the inflammatory process, because nature attempts to replace its lost epithelium of the alimentary canal just as it does that of the skin.

Obliteration of the lumen, partial or complete, was found to occur in 23.5 per cent. of 1,005 specimens removed for appendicitis alone, and 22.8 per cent. of 5,000 specimens removed for appendicitis alone and associated with other abdominal conditions, which include cholecystitis 52 per cent., cholelithiasis 44.8 per cent., and duodenal ulcer 26.9 per cent.

The youngest case in which the tip of the lumen was obliterated was five years of age, and the youngest complete obliteration was ten years of age. The oldest tip obliteration was sixty-seven years and the oldest total obliteration was sixty-nine years.

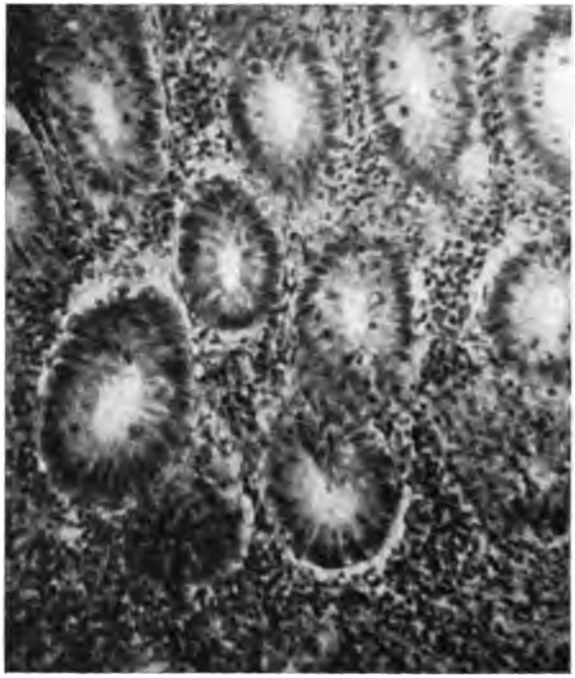


Fig. 137.—(No. 19460.) Showing hyperplasia and leukocytic infiltration of the epithelium at the point of obliteration.

The age at which the appendix is examined greatly modifies the conception of the time at which tip and total obliteration occur. When one examines appendices removed for appendicitis which come to operation at an average of 25.5 years, tip and total obliteration are found to be 29.8 and 34.6 years respectively. If, however, one examines appendices removed during the course of operation for cholecystitis and cholelithiasis, which cases come for operation at the age of 39.6 and 39.9 years, tip and total obliteration occur much later, respectively, 39.1 and 39.1 years.

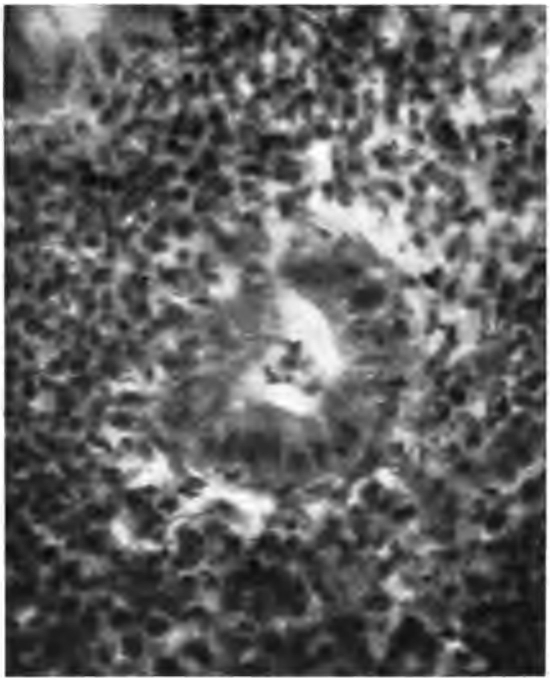


Fig. 138.—(No. 23188.) The remnant of a gland in an inflammatory mucosa.

Failure to realize this difference doubtless was responsible for the percentages found at autopsy by Ribbert, Aschoff, and others who apparently considered the process complete at the time of death, rather than the possibility of it having been complete years before death even at ten years of age.

The following tables consisting of statistics gathered from our cases, and where noted from other sources, graphically represent the facts as they are found.

The duration of the process of obliteration is not only interesting but important in refuting the normal involution idea of the process.

I.—OBLITERATION OCCURRING IN DECADES

	Partial and Complete Obliteration:			Partial Obliteration:
	Ribbert	Aschoff	MacCarty	MacCarty
1–10 years	4%	6%	0%	11%
10–20 years	11%	12%	3%	17%
20–30 years	17%	20.3%	8%	16%
30–40 years	25%	28%	15%	22%
40–50 years	27%	42%	16%	17%
50–60 years	36%	14%	17%	21%
60–70 years	53%	....	50%	50%
70–80 years	58%	....	0%	0%

II.—RELATION OF AMOUNT OF OBLITERATION TO THE AGE IN APPENDICITIS

Amount	Average Age at Operation	Average Duration of Symptoms
Tip	29.8 years	
$\frac{1}{5}$ and $\frac{1}{4}$	27.5 years	5.2 years
$\frac{1}{3}$	29.1 years	3.4 years
$\frac{1}{2}$	29.7 years	3.6 years
$\frac{3}{4}$	32.8 years	8.1 years
Partial	27.1 years	4.0 years
Average age of complete obliteration	34.6 years	4.0 years

III.—AVERAGE AGE WITH OBLITERATION IN CASES OF APPENDICITIS

Earliest tip obliteration	5 years
Earliest total obliteration	10 years
Latest tip obliteration	67 years
Latest total obliteration	61 years
Average age of complete obliteration	34.6 years
Average age of tip obliteration	29.8 years

IV.—AVERAGE AGE OF OBLITERATION IN THE APPENDIX ASSOCIATED WITH GALL-STONES AND CHOLECYSTITIS

Earliest tip obliteration	14 years
Earliest total obliteration	17 years
Latest tip obliteration	64 years
Latest total obliteration	69 years
Average age of complete obliteration	39.1 years
Average age of tip obliteration	39.1 years

V.—AVERAGE AGE OF OBLITERATION IN THE APPENDIX ASSOCIATED WITH OTHER ABDOMINAL CONDITIONS

Earliest tip obliteration	20 years
Earliest total obliteration	23 years
Latest tip obliteration	50 years
Latest total obliteration	64 years
Average age of complete obliteration	37.6 years
Average age of tip obliteration	32.5 years

VI.—SEX

Of all cases of appendicitis 55.5 per cent. were males, and 44.5 per cent. females. Of these, the cases showing one-fifth, one-fourth, one-third, one-half, and two-thirds obliteration, 44.8 per cent. were males and 55.2 per cent. females.

VII.—OCCURRENCE OF OBLITERATION OF THE LUMEN OF THE APPENDIX

Autopsy (2,549 cases) (Nowicki)	17.0%
Operation for appendicitis (1,005 cases)	23.5%
All cases examined (5,000)	22.8%

VIII.—SUMMARY OF TABLES III, IV, AND V

Earliest tip obliteration at age of	5 years
Earliest total obliteration at age of	10 years
Latest tip obliteration at age of	67 years
Latest total obliteration at age of	69 years
Average age of tip obliteration (appendicitis)	29.8 years
Average age of total obliteration (appendicitis)	34.6 years
Average age at operation for appendicitis	25.5 years
Average age at operation for cholecystitis and cholelithiasis plus stones	39 years
Average age of total and tip obliteration in cases with cholecystitis and cholelithiasis plus stones	39 years

IX.—DURATION OF THE ACTIVITY OF THE PROCESS OF OBLITERATION

			Appendices Associated with Cholecystitis	Other Abdominal Conditions
Years	*Years*	*Years*		
Youngest total 10	Eldest total...69	Average total 34.6	39.1	37.6
Youngest tip.. 5	Eldest tip.... 67	Average tip..29.8	39.1	32.5
Length of process........ 5	Length of process........ 2	Length of process........4.8	Length of process.00.0	Length of process. 5.1

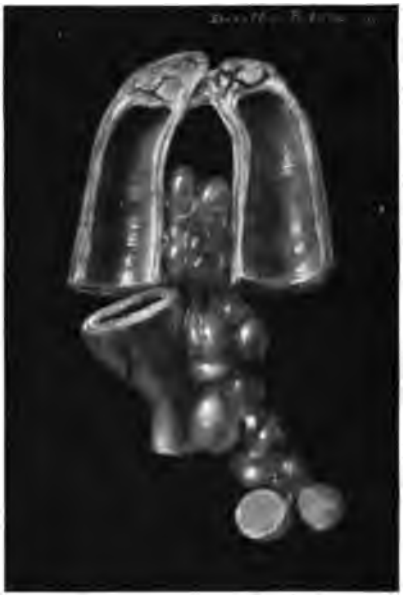
CARCINOMA

Carcinoma of the appendix occurred 22 times (0.44 per cent.) in 5,000 specimens.

First 1,000 specimens	5 or 0.5%
Second 1,000 specimens	7 or 0.7%
Third 1,000 specimens	3 or 0.3%
Fourth 1,000 specimens	2 or 0.2%
Fifth 1,000 specimens	5 or 0.5%

Seventeen of these were not extensive enough to be seen on the serosa nor to cause any enlargement, thereby making the diagnosis by the surgeon impossible. In one of the seventeen cases the growth had made its way through to the serosa and was

PLATE 6



Specimen, showing partial obliteration of the distal portion with dilatation of the rest of the appendix to within one centimeter of the cecum, at which point there is complete obstruction. The orange-colored area in the obliterated portion is carcinoma.

visible as a small orange-colored speck about one-half millimeter in diameter. This upon gross external examination was thought to be fat in the subserosa. Microscopic examination revealed it to be carcinoma which had reached this point through the lymphatics. Upon gross examination of formalin-fixed specimens the neoplasms in this series were orange-colored masses occupying all or a part of the submucosa and mucosa and not usually extending beyond the submucosa. The growth itself on gross section appeared as a homogeneous or finely granular mass occupying the center of the block, involving all the coats except the muscularis, subserosa, and serosa. The color was very characteristic in specimens preserved in formalin. (See Plate 6.) In all cases there was the same orange. This is very important in distinguishing the neoplasms grossly from lemon-yellow fat, which occurs in the submucosa and subserosa, especially in chronically inflamed or obliterated specimens.

Microscopically the growth consisted of alveoli filled with epithelial cells, the nuclei of which were in general oval or round and presented fewer irregularities than one usually sees in carcinoma in other portions of the alimentary canal. The size and lack of marked irregularity on the part of the nuclei as well as the alveolar arrangement and staining quality have been the cause of some observers calling the neoplasms endotheliomata and basal-cell carcinomata.

The microscopic picture of the epithelial cells of the mucosa, if studied in the normal appendix, in the chronically inflamed appendix, and in the partially obliterated appendix, is one of simple hyperplasia. In the normal and in the early chronically inflamed mucosæ the reaction consists of hyperactivity and many goblet cells may be seen. As the process becomes more chronic the picture changes from hyperactivity to a hyperplasia which seems rather to be an overproduction than over-function. The nuclei of the cells become larger in proportion to the amount of protoplasm. They take the stain less densely. In early carcinoma the cells vary in overproduction, size, and shape of the nuclei. The nuclei still resemble the nuclei of the remaining glands of the mucosa, and can be traced to them rather than to the endothelium of the lymph- and blood-vessels. As the growth becomes advanced and extends through the lymph-spaces the nuclei become more irregular and their identity becomes less certain, although in such advanced condition such qualities as irregularity of size and shape of the nuclei, staining properties, invasion of lymph-vessels, musculature, and peritoneum, as well as the definite descent from the glandular epithelium of the mucosa, may be seen.

At no time during the early growth do these cells resemble the epithelium of other portions of the alimentary tract, and in no case of this series was the growth far enough advanced to produce metastases, although metastases have been reported by other observers (Nowicki).

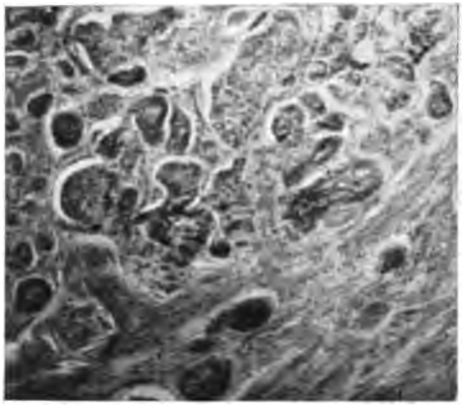


Fig. 139.—(No. 31326.) Carcinomatous islands in carcinoma of the appendix.

The youngest case occurred with acute appendicitis in a girl five years of age, and the oldest was found accidentally at autopsy upon a patient eighty years of age, who died after an operation for the removal of a stone from the urinary bladder. The same patient had a duodenal ulcer and cholecystitis. The next oldest case was a female, aged fifty years. The average age of all cases was thirty years, and the average duration of symptoms was

3.3 years. Thirty-one per cent. were found in appendices removed in association with other abdominal conditions. They occurred in 1.9 per cent., or once in every fifty-three partially or totally obliterated appendices. Seventy-three per cent. occurred in females.

The fact that 90 per cent. of the carcinomata occurred in the tip of the appendix and in partially or completely obliterated appendices is very important. One may practically conclude, in view of our experience with carcinoma in other regions, that it occurs here in association with a chronic inflammatory process, since it is seen more frequently at the tip, which is the point of activity in the process of obliteration—inflammatory process.

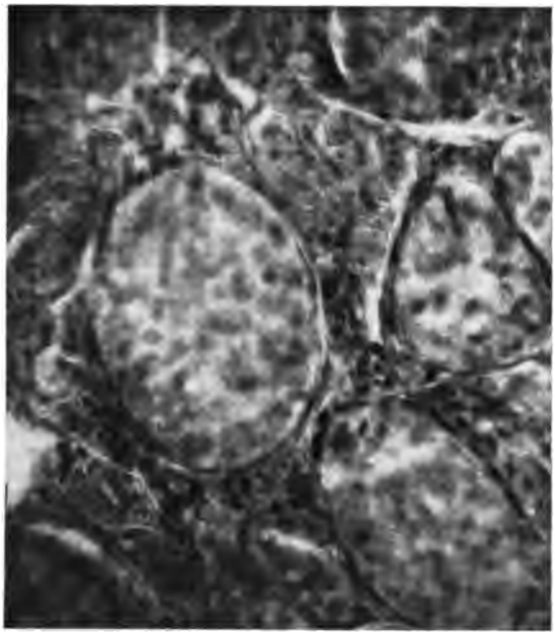


Fig. 140.—(No. 24497.) Alveolar arrangement of the perverted cells in carcinoma.

While studying these cases the question arose: How often does carcinoma of the cecum occur secondarily to carcinoma of the appendix? This is indeed difficult, if not impossible, to determine.

In 20 specimens of carcinoma of the cecum, which were examined by the writers, only one might have arisen from the appendix. In this case the growth was very extensive and its origin was doubtful. The fact that such a large percentage of the carcinomata arises at or near the tip speaks also against the frequent secondary involvement of the cecum.

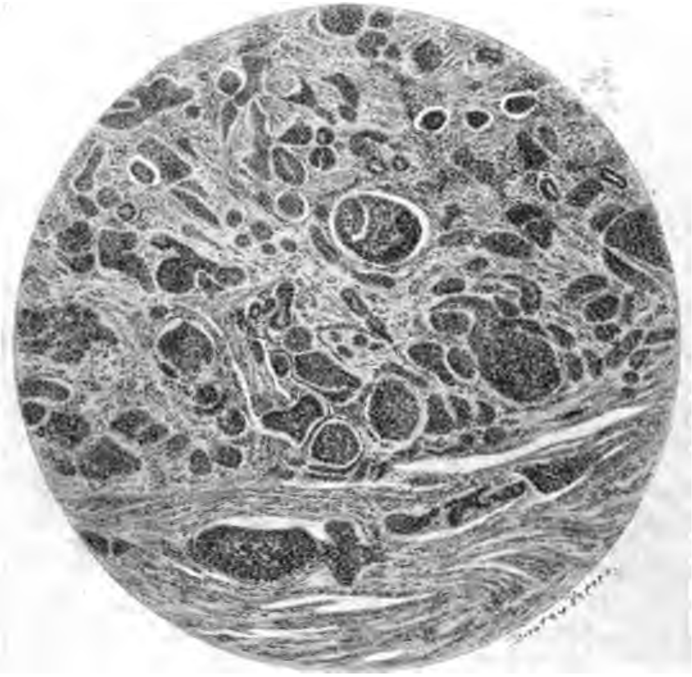


Fig. 141.—(No. 31005.) Involvement of the submucosa and the musculature by carcinoma.

The clinical significance of the occurrence of carcinoma of the appendix, as found in this series, may be summed up by saying that surgeons remove carcinomatous appendices, without suspecting malignancy, and the pathologist also is very apt to overlook them if the appendix is not opened and sectioned.

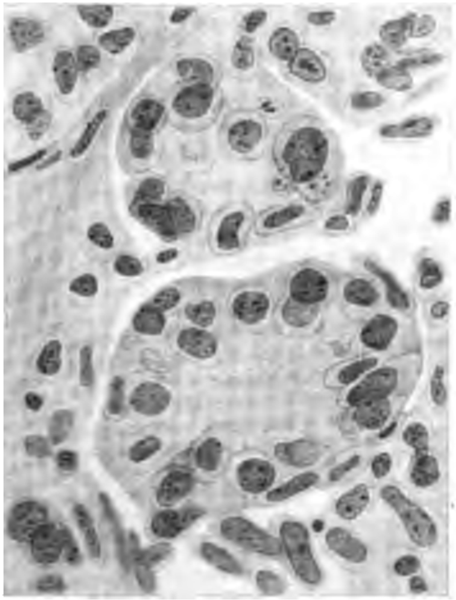


Fig. 142.—(No. 31005.) Showing the irregular character of the nuclei in early carcinoma of the appendix.

X.—CARCINOMA

5 carcinomata in first 1,000 specimens	0.5%
7 carcinomata in second 1,000 specimens	0.7%
3 carcinomata in third 1,000 specimens	0.3%
2 carcinomata in fourth 1,000 specimens	0.2%
5 carcinomata in fifth 1,000 specimens	0.5%
—	
22 carcinomata in 5,000 specimens	0.44%

77 per cent. were not diagnosed from their gross external appearance.
Youngest, five years old (female, death from acute appendicitis).
Eldest, eighty years old (male, death after removal of stones in the urinary bladder).
73 per cent. were females.
90 per cent. occurred in partially or completely obliterated appendices.
90 per cent. occurred at the tip of the appendix.
Average age thirty years.
Average duration of symptoms, 3.3 years.
1 in every 53 partially or completely obliterated appendices was carcinomatous.
1 in every 225 of all appendices in this series was carcinoma.
31 per cent. were found in association with other abdominal and pelvic conditions.
0.6 per cent. of the carcinomatous appendices were removed in association with other conditions.

The occurrence of 90 per cent. of the neoplasms in appendices, the lumena of which are being or have been obliterated, and the fact that carcinoma occurs in one of every fifty-three partially or completely obliterated appendices, demand the removal of such appendices instead of leaving them, because we think that nature is taking care of the process, or that the process is a normal physiologic involution.

According to this series, the surgeon may save one in every 225 cases from carcinoma of the appendix by removal of that structure when such removal is possible.

HISTORIES OF THE CASES OF CARCINOMA

Hospital No.	Age	Sex	Duration of Symptoms	Location of Pain	Fever	Vomiting	Jaundice	Condition Found
28043	26	F.	4 yrs.	Right iliac region	+	..	..	Chronic appendicitis.
28359	50	F.	15 yrs.	Umbilical region Right iliac region	..	..	..	Chronic appendicitis. Tumor on the end of the appendix. Carcinoma.
26527	25	F.	4 yrs. 3 yrs.	Epigastrium Right iliac region	..	..	..	Chronic cystic appendix.
18030	33	M.	2 yrs.	Abdomen (gen.) Right iliac region	+	+	..	Cirrhosis of liver. Carcinoma at base of appendix.
17259	20	F.	Several years	Right iliac region	..	..	..	Subacute appendicitis. Carcinoma of tip of appendix.
31005	23	F.	8 yrs.	Right iliac region to back	..	..	..	Chronic appendicitis.
25862	30	M.	1 yr.	Abdomen (gen.) Right iliac region	+	+	..	Chronic appendicitis.
31023	37	F.	4 yrs.	Umbilical region Right iliac region	+	+	..	Chronic appendicitis. Gall-bladder thickened.
31326	26	F.	8 yrs.	Right hypochon. Right iliac region	+	+	..	Chronic appendicitis.
31679	5	F.	Since birth	....	..	+	..	Chronic appendicitis. Enlarged glands in mesentery.
32898	22	F.	8 mos.	Right iliac region	+	+	..	Chronic appendicitis.
29613	27	F.	7 wks.	Right iliac region Right hypochon.	..	..	+	Chronic appendicitis (adherent).
24497	42	M.	3 mos.	Epigastrium	..	..	..	Right inguinal hernia. Chronic appendicitis.
34532	80	M.	10 yrs.	....	..	..	..	Four stones in urinary bladder.
33079 office	..	F.	....	....	..	..	..	Subacute appendicitis. Cholelithiasis.
32682	34	F.	4 mos.	Right iliac region	..	+	..	Endometritis and uterine fibroids. Appendicitis. Carcinoma of tip of appendix.
31580	16	F.	2 yrs. 10 days	Right iliac region Right iliac region	+	..	..	Acute appendicitis.
21362	29	M.	11 yrs. 1 mo.	Right iliac region Right iliac region	+	+	..	Acute appendicitis. Small abscess in omentum.
23043	26	F.	2 yrs.	Right hypochon.	..	+	+	....
*Carc	A	..	..	....	..	..	..	....
*Carc	B	..	..	....	..	..	..	....
*Carc	C	..	..	...	..	.	.	...

* Labels blurred or lost.

HISTORIES OF CASES OF DIVERTICULUM

Hospital No.	Age	Sex	Duration of Symptoms	Location of Pain	Fever	Vomiting	Jaundice	Condition Found
22429	53	M.	10 yrs.	Right iliac region Umbilical region	..	..	..	Acute appendicitis.
22170	40	M.	10 yrs.	General abdomen Right iliac region	..	..	..	Acute appendicitis.
34981	28	M.	..	....	..	..	..	Abscess in region of kidney.
31878	26	F.	..	....	..	..	..	Acute appendicitis.
24191	40	M.	8 yrs. later 2 mos.	Right iliac region	..	+	..	Chronic appendicitis.
26098	64	F.	30 yrs.	Epigastrium	..	+	..	Cystic appendix. Cholelithiasis.
21793	27	F.	1 yr.	Right iliac region	.	..	..	Acute appendicitis.
21761	38	F.	7 mos.	Right iliac fossa	+	+	..	Acute appendicitis (abscess).
20140	56	M.	5 yrs.	Right lumbar General abdomen	+	+	..	Acute appendicitis (abscess).
19777	36	M.	..	....	..	..	..	Chronic appendicitis.
Case A	..	..	..	Label was lost	..	..	..	....
25436	18	M.	1 yr.	General abdomen Right iliac region	+	+	..	Acute appendicitis. Small abscess.
28853	27	M.	5 yrs.	Right iliac region	..	+	..	Chronic appendicitis.
31277	24	F.	5 yrs. 2 mos.	Right iliac region	+	+	..	Subacute appendicitis.
25623	44	F.	8 yrs. 5 yrs.	Right hypochon. Right iliac region	+	..	..	Subacute appendicitis. Cholelithiasis.
30982	27	M.	..	Epigastrium	..	..	..	Subacute appendicitis.
21809	30	F.	6 mos. 2 wks.	Abdomen Abdomen	+ +	+	..	Acute appendicitis. Tip adherent to small bowel.

XI.—DIVERTICULUM OF THE APPENDIX

17 cases in 5,000 specimens.
They were usually multiple.
56 per cent. occurred in acute appendicitis.
Youngest, 18 years.
Eldest, 64 years.
Average age at operation, 34 years.
Average duration of symptoms, 7 years.

XII.—STONES AND OTHER FOREIGN BODIES

57 specimens of 5,000 contained fecaliths, fruit-seeds, hairs, tooth-brush bristles, birdshot, pins, or gall-stones.

Diverticulum

Diverticulum of the appendix occurred, usually as a multiple condition, in 17 cases. The diverticula were grossly visible, but varied greatly in size, the largest in the series being about one-half centimeter in diameter and projecting beyond the surface about one-half centimeter. They were covered by serosa and varied in color according to their contents. They consisted of evaginations of the submucosa, muscularis mucosæ, and mucosa through an opening in the muscular coats. The edges of this opening were rounded off and permitted the tissues of the submucosa, which fused with the subserosa, to pass around it in a well-defined manner. The wall of a diverticulum consists only of the mucosa, muscularis mucosæ, submucosa, subserosa, and serosa. These coats are thinner than normal.

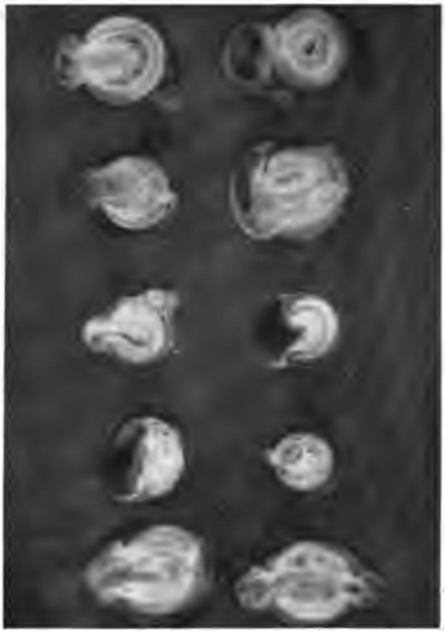


Fig. 143.—(Nos. 35436, 34981, 28853, 25623, 30921, 30982, 21793, 31277, 21761, 29669.) Photographs of gross blocks taken through specimens of diverticula of the appendix.

The condition was found in a wide range of ages, the eldest sixty-four years and the youngest eighteen years.

Fifty-six per cent. of the cases occurred in acute appendicitis. Fifty-six occurred in females. The only cases that were found in association with other conditions were removed with gall-stones. There were two such cases. In one of these the appendicitis was subacute, the other acute. The average duration of the symptoms was seven years and the average age at operation is thirty-four years. Two complained of pain in the epigastrium and one in the right hypochondrium. The condition does not seem to bring about symptoms so early in life as the appendix ordinarily does, but a higher percentage occurs in acute appendicitis.

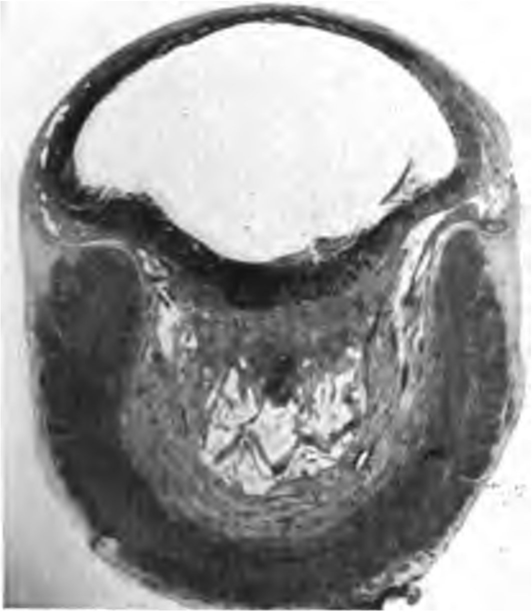


Fig. 144.—(No. 31277.) Section showing the coats and character of a diverticulum of the appendix.

CONCLUSIONS

1. This series confirms the percentage of obliteration found in the appendix by other observers.

2. Obliteration seems to occur as the result of an inflammatory process, as shown by its histology, the time of occurrence, its irregularity of occurrence, the duration of the process, and the higher frequency in appendicitis than at autopsy in general.

3. Many appendices become acutely inflamed during the process

organs that existed when they were a part of the simple primitive tube.

Physiology demonstrates the remaining necessity for products of digestion to pass in contact with the same alimentary cells (now the liver and pancreas) with which they came in contact in the primitive individual.

Autopsy has shown that duodenal ulcers when they occur at or near the papilla of Vater are sometimes, if not always, associated with cholecystitis, and occasionally with chronic interstitial hepatitis (cirrhosis).

The first case, No. 27,238, was a male aged sixty years, who was operated upon for cholecystitis seventeen months before the last operation. He was improved for five or six months, and again had epigastric pain, jaundice, and vomiting. At the second operation, which was performed at St. Mary's Hospital, the gall-bladder was found distended, the common duct dilated, and the head of the pancreas very hard. A note at operation stated that, if a third operation should be necessary, it should be cholecystenterostomy. The patient died on the twelfth day after operation. Postmortem examination revealed a marked cirrhosis of the liver, chronic catarrhal cholecystitis (strawberry gall-bladder), chronic pancreatitis, chronic congestion of the spleen, and a chronic ulcer of the duodenum at the ampulla of Vater, about 1 cm. in diameter. There was almost complete stenosis of the common duct in the base of the ulcer.

The second case, No. 31,049, was a male, aged fifty-eight years, who, four years before examination, had attacks of severe epigastric pain which radiated to the back. Seven weeks before the last operation he had similar attacks accompanied by vomiting. At operation the gall-bladder was drained for cholecystitis with one stone, and a hard mass was felt at the end of the common duct, which was thought to be carcinoma of the head of the pancreas. On the fourth day after the operation the patient died from a hemorrhage into the bowel, associated with tarry stools and hematemesis. At autopsy a duodenal ulcer 2 cm. in diameter was found. The lumen of the common duct extended apparently unobstructed through the base of the ulcer.

The third case, No. 31,501, a male, aged fifty-six years, had his first attack of pain in the epigastrium three months before examination. The pain was referred to the right costal arch. A week later he had severe pain in the same region. This was accompanied by slight jaundice, no vomiting, but fever and constipation. He suffered from gas belching, bloating, and headaches. At operation a large stone was removed from the neck of the gall-bladder, which it obstructed. The patient had a fatal hemorrhage into the bowel. At autopsy an ulcer of the duodenum was found.

Clinical experience presents strong evidence that there are gastric disturbances which are relieved and often completely dissipated by the removal of the appendix.[8]

Experimental physiology and pathology demonstrate that partial obstruction of the common duct is followed by cirrhosis of the liver;[6] and that irritants in the large bowel cause retardation of the muscular rhythm of the stomach and intestines;[4] and that experimental gastric ulcers which do not heal can be produced by trauma plus anemia, but not by trauma alone.[5]

Examination of the appendices removed in association with "pyloric spasm,"[*] gastric and duodenal ulcers, cholecystitis and cholelithiasis shows that there is a higher percentage of appendices with partially or completely obliterated lumina[†] in all of these conditions, than at general autopsy or at operation for appendicitis.

Specimens examined at autopsy and operation showed the following percentages:

Autopsy in	2549 cases[9]	17	per cent. partially or completely obliterated
Pyloric spasm	17 cases	17	per cent. partially or completely obliterated
Appendicitis	1005 cases	23.5	per cent. partially or completely obliterated
Gastric and duodenal ulcers	52 cases	26.9	per cent. partially or completely obliterated
Cholecystitis	57 cases	52	per cent. partially or completely obliterated
Cholelithiasis	118 cases	44.8	per cent. partially or completely obliterated

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[*] "Pyloric spasm" has been used clinically to denote an indefinite, apparently functional disturbance in the stomach evidenced by indigestion, pain, bloating, and dyspepsia.

[†] Obliteration of the lumen of the appendix is practically universally accepted by pathologists to-day to be the result of a mild or acute inflammatory process. The increase in the percentage of the obliterated or partially obliterated lumina does not increase gradually with the increasing decade. The greatest increase and the greatest activity in the process occur during the period in which appendicitis is most common.[3]

In the previous studies[2] it was found that 23.2 per cent. of 365 cases in which cholecystectomy was performed showed symptoms which began at or under twenty-five years of age, the period during which appendicitis is most common, and that 13 per cent. of these cases gave definite histories of pain and soreness in the region of the appendix. In 59 of these cases of cholecystitis the appendices were removed, and 69 per cent. showed undoubted gross or microscopic evidence of inflammation, varying from a chronic catarrhal condition to complete obliteration and periappendicitis.

In the examination of 2,000 appendices, with their histories, 52 per cent. of 175 cases of cholecystitis with and without stones gave histories of pain in the region of the appendix.

In 1,147 histories, which include all the cases of appendicitis and appendices removed during operations for conditions other than cholecystitis with or without stones, there was a history of pain in the epigastrium or right hypochondrium in 13 per cent. In 9.4 per cent. there was pain in the "abdomen" and in 14.6 per cent. pain in the "abdomen which radiated to and became localized in the region of the appendix."

The ages of patients at onset of symptoms of appendicitis, pyloric spasm, duodenal ulcer, gastric ulcer, cholecystitis, and cholelithiasis are as follows: 23.5 (1,005 cases), 24.2 (18 cases), 31 (30 cases), 35 (10 cases), 34.7 and 33.8 years respectively. These conditions come to operation in the same order at the ages of 25.5, 34, 41, 48, 39.6, and 39.9 years. This order is exceedingly important if subsequent observations on a larger series of cases confirm it.

It is the rational course of events to be expected upon the hypothesis that irritation in the appendix and cecum reflexly cause gastric and duodenal disturbances, which in turn interfere with the mechanism of secretion, storage, and outflow of the bile, thereby producing conditions favorable for bacterial infection in these organs and the gall-bladder.

A consideration of the average duration from the onset of symptoms to operation, in appendicitis, cholecystitis, and cholelithiasis, reveals respectively 2, 4.9, and 6.5 years. It will be seen that the average duration in cases of cholecystitis lies between the average in appendicitis and cholelithiasis.

The question arises, Is this a mere coincidence, especially when we know that simple cholecystitis precedes gall-stones? Is there any relationship between these conditions? Are we dealing with a process which manifests itself in three stages, namely, appendicitis, simple cholecystitis, and cholecystitis with stones?

The average age at the onset of symptoms in these three conditions is also of interest, although there is not the same parallel. In appendicitis it is 23.5 years, in cholecystitis 34.7 years, and in cholelithiasis 33.8 years. There is one thing to be considered, however, and that is the fact that the symptoms in cholelithiasis are likely to be more sudden and severe, and therefore demand earlier attention than in simple cholecystitis.

There is a marked contrast between the percentage of appendices with partially or completely obliterated lumina at general autopsies and at operations for appendicitis, and that found in appendices which have been removed in association with cholecystitis and cholelithiasis: 23.5 per cent. at operation, 17 per cent. at autopsy, and 52 per cent. in association with inflammation of the gall-bladder, have partially or completely obliterated lumen; 8.7 per cent. of 2,000 appendices were associated with cholecystitis.

In spite of the fact that a higher percentage of males were operated upon for appendicitis than females (55.5 per cent. males and 44.5 per cent. females), partial obliteration of the lumen occurred more often in females (55.2 per cent. females and 44.3 per cent. males). This may be one of the coincidents which lead to false deductions in all statistics, but the figures are sufficiently significant to be kept in mind as possible evidence of the probable fact that the inflammatory processes in the appendix cause disturbances in the bile-passages directly or indirectly, in view of the fact that cholecystitis is decidedly more frequent in females than in males.

These figures, which are the result of examination of the histories and specimens of 2,000 cases in which the appendix was removed for appendicitis primarily or secondarily to other abdominal conditions, are sufficiently important, not to prove, but to stimulate, a careful study of clinical histories with relation to the possibility that chronic inflammation in the appendix reflexly disturbs the gastro-duodeno-hepatico-pancreatic physiologic system, thereby bringing about conditions whereby such lesions as gastric ulcer, gastric carcinoma, duodenal ulcer, cirrhosis, cholecystitis, cholelithiasis, and pancreatitis may be indirectly produced.

During the examination of histories and surgical reports of upper abdominal conditions in which a high percentage of appendices had obliterated or partially obliterated lumina, it was thought that perhaps the technical difficulties in removal of an appendix through a high incision might influence the percentage, in view of the surgeon's ability to recognize such pathologic lesions in the appendix by palpation more readily than less extensive conditions. With this possibility in view, all of the upper abdominal conditions which were not apparently gall-bladder conditions were studied with the following results. In this series there were 46 upper abdominal incisions with 15 (32 per cent.) partially or completely obliterated appendices. For comparison those cases of lower abdominal incisions were taken and in 223 cases, 85 (38 per cent.) appendices were partially or completely obliterated. In 275 cases in which the stomach, duodenum, gall-bladder, and pancreas were explored and reported negative through the lower abdominal incision (straight or muscle splitting), 99 (36 per cent.) of the appendices were either partially or completely obliterated. In all of the upper abdominal conditions examined through high incisions and in the cases reported negative through low incisions, there were apparently symptoms in the epigastrium which required investigation.

This is merely more clinical evidence that individuals who present a higher percentage of obliterated or partially obliterated appendices at operation do have symptoms referable to the epigastrium, and that the percentage is lower when no recognizable pathologic lesion was found than in cases in which definite changes were found. They are all suggestive enough to demand further experimental evidence upon the subject, and until they are disproved the surgeon should remove the appendix in all cases of chronic appendicitis and in association with lesions in the gastro-duodeno-hepatico-pancreatic physiologic system when such an operation can be done with little or no extra risk to the patient. During laparotomies the appendix should be removed when such procedure does not materially add risk to the operation.

By this means there is a great possibility of reducing the number of lesions in that physiologic system.

A careful study of the subsequent histories of all cases operated upon for appendicitis should be made in order to determine what percentage of them have developed gastric ulcer, gastric carcinoma, cholecystitis, cholelithiasis, cirrhosis, and pancreatitis.

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MECKEL'S DIVERTICULUM: A REPORT OF FIFTEEN CASES*

BY DONALD C. BALFOUR

In the development of the human embryo the normal closure and obliteration of the intra-embryonic segment of the vitelline duct, which should occur about the fifth week, occasionally does not take place, and the duct persists as a structure of varying extent. The anomaly may be a complete tube connecting the part of the intestine to which it is attached and the umbilicus, thus forming an umbilical anus. More commonly only a portion of the duct remains, and this portion is in the form of a cylindric tube attached to some part of the small bowel.

Although previous observers had recognized and described the condition, this diverticulum is particularly associated with the name of Meckel, for he was the first to direct attention to its importance as a cause of intestinal obstruction and other complications.

Between the two conditions, *i. e.*, a complete tube from bowel to umbilicus and a free diverticulum, many variations are found. Very often a cord connects the apex of the diverticulum with the umbilicus, which contains the remains of the umbilical vessels, or this cord may persist independently and find its own attachment to the umbilicus.

Meckel's diverticulum is usually about 3 inches in length. It is smaller than the intestine with which it is connected, is composed of the same coats, and it may be situated at any part of the small bowel, from the pylorus to the cecum; however, it is usually found about 2 or 3 feet from the ileocecal orifice, and almost always on the free surface, *i. e.*, opposite the mesentery. As to the frequency of its occurrence, various observers give different figures, the average being about 2 per cent. in autopsy cases.

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* Read before the Southern Minnesota Medical Association, Dec. 6, 1910. (Reprinted from "The Northwestern Lancet," March 1, 1911.)

The diverticulum by itself rarely causes any trouble, yet it is subject to the same pathologic processes as the vermiform appendix, and an acute inflammatory condition and perforation is always possible. Foreign bodies, varying from grape-seeds to a Murphy button, have been found lodged in its lumen. In the literature of intussusception several cases have been reported originating in Meckel's diverticulum which either were caused by the peristaltic activity of the diverticulum or were brought about by a stricture of the gut in the region of the diverticulum. A few cases have been reported in which the diverticulum was the only structure in the sac of a strangulated inguinal hernia. Lastly, the diverticulum may cause obstruction by kinking the bowel, or by invaginating itself into the lumen of the bowel, so that one may appreciate the force of the statement that "a Meckel's diverticulum is more dangerous than the vermiform appendix." In the majority of instances, however, the danger in this congenital deformity is not from the diverticulum itself, but is due, rather, to a band which is usually present, reaching from the tip of the diverticulum to some other point in the abdominal cavity, usually the umbilicus. This cord, or band, usually contains the remnants of the omphalomesenteric vessels in a varying degree of atrophy, and when present it is a very frequent cause of obstruction. Loops of intestine, usually the lower ileum, may become constricted by this band and set up an obstruction which rapidly becomes serious and often fatal unless relieved by surgical interference.

As regards the diagnosis of such a condition: It seems that one should be able occasionally to recognize the symptoms, and yet, owing either to the infrequency of the condition or to the indefinite character of the symptoms, a correct diagnosis is but rarely made.

A history of previous attacks of obstruction, coming suddenly and leaving suddenly, which would distinguish them from appendicitis or other inflammatory lesions, might be of some service.

However, an absolute diagnosis is not necessary, as symptoms of such an obstruction should call for surgical interference.

In a review of 10,600 abdominal operations at St. Mary's Hospital (Mayo Clinic) during the past three years, I have collected 15 cases of Meckel's diverticulum. This percentage is of no particular value, because it is not an actual indication of how frequently the condition may have been present. Only in a comparatively few laparotomies is there any necessity for a systematic search for such an anomaly. For example, in the various stomach and gall-bladder operations in which sufficient evidence is found to explain the symptoms there would be no reason to explore the intestinal tract inch by inch in search of further trouble. In many instances the condition has been discovered during the course of operations for other conditions, and when it had not caused any symptoms. For this reason I have classified the cases collected into two groups as follows:

Group 1: Those in which the diverticula were producing the symptoms from which the patient sought relief.

Group 2: Those in which the diverticula were removed to avoid possible future complications.

There are five cases in the first group, and on account of the varieties of the lesions it may be of interest to review, briefly, each case.

Case A 7,463.—Girl, aged sixteen years, complained of cramping pain low in the right side of the abdomen, of rather short duration, with no fever or vomiting, but accompanied by subacute obstruction of the bowels; at times unable to obtain a bowel movement for four or five days. The operation disclosed an acutely inflamed diverticulum of the ileum, some two feet above the ileocecal valve, which was producing a moderate degree of constriction by adhesions. The diverticulum was ligated, and the stump inverted, just as an appendix would be treated.

Case A 18,552.—Married woman, aged twenty-seven years, gave a history of having had since a child several attacks of low abdominal inflammation, more localized to the right side and associated with obstipation. She was confined to bed from one to four weeks with the attacks. At operation a diverticulum from the ileum, about 2 feet above the ileocecal valve and extending to the umbilicus, was found. It was a little larger than a slate-pencil and about 9 inches in length, and formed a loop through which the entire cecum and appendix had slipped, producing a chronic obstruction. The lumen of the diverticulum extended to the tip, and it was necessary to excise the umbilicus through a separate incision before the diverticulum could be removed.

CASE A 20,686.—Male, aged two years, consulted on account of a discharging navel, which condition had been present for over a year; no fecal matter, but occasionally quite severe bleeding; no other symptoms. The child was given an anesthetic, and the umbilicus curetted and drained. The discharge persisted, however, and a few days later the abdomen was opened and a diverticulum found connecting the ileum and navel. The umbilicus and diverticulum were excised, and the opening in the abdominal wall closed as an umbilical hernia.

CASE A 27,460.—Male, aged five years, was sent from a neighboring town with complete obstruction of the bowels. An emergency operation revealed a large diverticulum extending from the ileum to the umbilicus. After resecting the diverticulum it was found necessary to perform a lateral anastomosis between the loops of the ileum above and below the constricting point, in order to secure a free intestinal canal.

CASE A 38,550.—Male, aged fifty-seven years, gave a history suggesting a lesion in the gall-bladder, and was explored for that reason. The operation, however, disclosed an inflamed diverticulum 3 inches above the ileocecal orifice, causing an intussusception at the base. The diverticulum was removed, and the stump invaginated in the usual way.

The remaining ten cases fall into the second group, *i. e.*, those which were not producing symptoms sufficient to be complained of; yet, in a few of this number, the diverticulum showed active pathologic changes. For example, Case 45,454 had a diverticulum 4 inches in length closely adherent to the side wall of the ileum and having its origin 18 inches from the ileocecal valve. The tip was inflamed and looked quite like an acute appendix. The patient, however, had no definite history of trouble which could be associated with such a condition, but came for consultation because of multinodular fibroids of the uterus, for which the operation was being performed.

The majority of cases in this series, however, were those of uncomplicated diverticula, varying in situation on the ileum, and were all treated by amputation and invagination.

This brief paper may serve to show that Meckel's diverticulum and its associated conditions should be borne in mind in obscure inflammatory processes of the lower abdomen; and especially in those cases of supposed acute appendicitis in which the appendix does not appear to be sufficiently involved to explain the symptoms the ileum should be explored for a possible acutely diseased Meckel's diverticulum.

A CASE OF CARCINOMA ON DIVERTICULITIS OF THE SIGMOID*

By H. Z. GIFFIN and LOUIS B. WILSON

Clinical Report by H. Z. Giffin.—In a previous paper† W. J. Mayo and the authors of this paper reported the operative technic, the pathologic findings, and the clinical histories in five cases of acquired diverticulitis of the sigmoid. Since that time several important articles have appeared upon this subject, notably those of Telling, Brewer, and Franke. Telling's paper‡ is an exhaustive study of 105 cases collected from the literature, including those cases operated upon, those discovered at autopsy, and a number found upon reëxamination of numerous museum specimens. Judging from the abstracts of these cases, 27 were operated upon. In only 12 of these was the condition recognized as diverticulitis at operation, or shortly afterward. Eleven of the 27 were thought to be malignant. In 5 of the 12 cases recognized as diverticulitis resection of a portion of the bowel was done. In 3 cases an inflamed diverticulum was resected, in 2 others a perforation was sutured, in 1 an abscess was drained, and in 1 an anastomosis was made. Brewer's paper§ reports a second operation upon a patient who had previously had an abscess drained (included in Telling's paper). This was the resection of a diverticulum acutely inflamed and about to rupture. The diverticulum was treated like an acutely inflamed appendix. Franke|| reports one undoubted

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* Reprinted from "Am. Jour. Med. Sci.," Nov., 1909. (Copyright, 1909, by Lea & Febiger.)

† "Surg., Gyn., and Obst.," July, 1907; "Trans. Amer. Surg. Assoc.," 1907, pp. 240-244.

‡ "Lancet," March 21 and 28, 1908.

§ "Jour. Amer. Med. Assoc.," Aug. 15, 1903.

|| "Deut. med. Woch.," xxxv, No. 3.

case, diagnosticated before operation and confirmed by pathologic examination, in which resection was done. This case is not included in Telling's collection.

In the above list of cases there is but one instance of operation upon what proved to be carcinoma developing upon diverticulitis. The following case, which, through the kindness of C. Graham and W. J. Mayo, we have the privilege of reporting, is, therefore, of importance.

H. B., aged sixty-eight years (A 18,633), male, gave a four years' history of intermittent complaint. At first there was a bloody dysentery of four or five days' duration, with some low abdominal pain. Then for a year or more the patient felt well. Three years previous to operation he was sick three days with quite a severe pain low in the left side of the abdomen, without vomiting, and with little other complaint. Six months previously he had a similar attack, with vomiting and chill, the pain being well localized in the left lower quadrant. There had been no complaint whatever between these attacks. One month before operation another attack occurred and a mass was palpated. A very slight loss of flesh had occurred in the latter weeks, and there was more or less soreness in the side and an occasional chill. The general condition was quite good. The mass persisted to the time of operation, and was as large as an orange. The patient had noticed some blood in the stools during the last month, and a few times the passage of small hard masses of feces, which stained the water about them a reddish color. In attempting to arrive at a clinical diagnosis Graham placed carcinoma first and diverticulitis second.

The patient was operated upon January 21, 1909, by W. J. Mayo. A carcinoma was found at the juncture of the descending colon and sigmoid. It had evidently had its origin in a preëxisting diverticulitis. A number of diverticula were also found without carcinomatous change. The tumor had perforated into the left iliac fossa, and an abscess, very much like an appendiceal abscess, existed, with extensive adhesions. It contained a few drams of sterile pus. The entire descending colon and iliac portion of the sigmoid, including the infected peritoneum, were removed. A lateral anastomosis between the splenic flexure and the pelvic sigmoid was made. Drainage was provided by rubber tissue leading through the incision down to the anastomosis and by two stab wounds, each with two rubber-tissue drains.

The case from the literature above referred to is reported by Hochenegg. The following abstract is quoted from Telling's paper (Hochenegg,* 1902):

> The patient, aged seventy years, had suffered from constipation. A carcinoma of the sigmoid flexure was resected; the flexure showed for a great distance numerous cherry-sized diverticula, filled with somewhat hard, plastic fecal matter. The carcinoma was regarded as resulting from the chronic irritation and ulceration of the diverticula, due to the retained feces.

Two other cases are reported by Telling which illustrate the association of carcinoma and diverticulitis. These were discovered at autopsy (Telling,† 1907):

> Male, aged fifty-eight years. Constipation and flatulence for many years. Symptoms worse, with loss of weight, and for some time previous to admission. Shortly after this the patient developed general peritonitis and died. At the necropsy there were found the following: (1) Perforating appendicitis. (2) Multiple diverticula of the lowest 4 inches of the sigmoid flexure. This was thickened, increasingly from above downward; it was fibro-fatty in nature, and was most marked opposite the mesosigmoid. The diverticula were, for the most part, currant-sized, contained fecal concretions, and in many cases entered the appendices epiploicæ. But all were not so situated; some were between the layers of the mesosigmoid. In some, ulceration had occurred, and this had led to the chronic perisigmoiditis, and consequent partial narrowing of the gut. The diverticula had "lipped" openings. (3) At the splenic flexure was a narrow, stenosing carcinoma, with a papillary surface toward the lumen of the bowel. It practically encircled the gut and caused partial obstruction. In it were to be made out several "pockets," suggesting those noted in the sigmoid flexure, but this origin could not with certainty be determined. At the edges of the growth were several "cysts" filled with mucus. The gut between the splenic and sigmoid flexures presented no diverticula. "This case is interesting from the presence of three different lesions which may, however, be connected. Assuming that the chronic constipation caused the diverticula, the thickening of the bowel from the chronic diverticulitis would increase the constipation, and the resulting irritation to the bowel may have

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* "Verhand. der deut. Gesells. f. Chir.," 31.

† Loc. cit.

occasioned the carcinoma above, even if this was not directly due to the irritation of diverticula at this spot. The increasing obstruction of the bowel from the carcinoma was probably a predisposing cause to the perforating appendicitis."

The second case, an aged female, was reported by Stierlin:* Multiple diverticula were found above a stenosing carcinoma of the sigmoid flexure.

Diverticulitis of the sigmoid has been brought to our attention frequently enough within the last few years to make us think of its possibility in every case of abdominal cramp, especially when symptoms or signs are later localized in the left lower abdominal quadrant. Most of all should it be considered in a history of recurrent attacks over a period of years, and when a mass is palpable. One is quite safe in excluding a primary carcinoma if the history of attacks runs back for a year or two, thus arriving at a tentative diagnosis of carcinoma on diverticulitis in case the signs point to present malignancy. Only a provisional diagnosis will, of course, be possible in any case. The weight may remain close to normal even after malignancy has developed, but the general condition of the patient will be better if carcinoma be developing on a preexisting inflammatory condition than one would expect with a primary cancer of equal size.

If one can ascertain how long a tumor has existed, the relation between this and the patient's general condition may be of assistance in pointing either to a primary carcinoma or carcinoma on diverticulitis.

Not infrequently cases are met clinically which give a history of one or two attacks of abdominal cramp localizing quite definitely in the left iliac fossa. No mass is palpable, but pressure on the gut is painful. Most likely a number of these cases are diverticulitis, and their future history will bear careful watching. Again, if surgical pathologists will carefully examine all specimens of carcinoma of the large bowel for the possible occurrence of diverticula, something will be done toward clearing up the question of the actual frequency of malignant change in diverticulitis.

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* "Corresbl. f. Schweitzer Aerzte," xxxii, p. 749.

Pathologic Report by Louis B. Wilson.—When the specimen was opened longitudinally a fungoid carcinoma about 6 cm. in transverse diameter presented itself. The base of the tumor was on the mesenteric side of the viscus. In examining the specimen it was found possible to pass a probe into a deep pocket which penetrated the carcinoma well within its margin. The specimen was fixed in Kaiserling's fluid and then sectioned longitudinally. Four diverticula were found. The one which had been determined by probing before fixation is shown in Fig. 145. Its lining mucosa had been somewhat damaged by the insertion of the probe, yet its character can be readily seen in the photograph. The carcinoma completely enveloped the diverticulum. It is possible that another diverticulum may have been present at the point occupied by the center of the tumor mass, as is indicated by some fine dark lines at this point in Fig. 145. It is, however, impossible to say that this is the case, since the mucosa has been so completely destroyed. Fig. 145 also shows very nicely the enlarged glands within the mes-

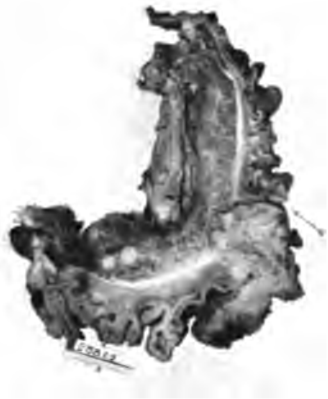

Fig. 145.—Carcinoma on diverticulitis of the sigmoid. The specimen was fixed in Kaiserling's solution, sectioned longitudinally and photographed, immersed without staining. The arrow points to the diverticulum, most of the mucosa of which has been destroyed by necrosis. Above the arrow is seen the main mass of the carcinoma, within the center of which are some faint lines indicating what was probably a diverticulum. To the left are seen the transverse sections of glands containing carcinomatous metastases. × ⅔ diameter.

entery, which were found, on microscopic examination, to be filled with carcinomatous metastases.

The section knife revealed two diverticula placed laterally to the one just described, and just within the border of the carcinoma. These are shown in Fig. 146. It will be seen that they have penetrated the muscularis, and a large amount of inflammatory tissue has been thrown out in the subserosa, causing adhesions which have been torn away by the operative procedure. In these two the mucosa is well preserved, and it is only their inner ends that are affected by carcinomatous tissue. A fourth diverticulum was found on the side opposite the preceding two, and completely outside of the carcinomatous area. This is shown somewhat magnified in Fig. 147. This diverticulum is exactly like certain ones previously described by me.* It is a false diverticulum, that is, all the walls of the viscus are not carried outward, but the muscularis is penetrated by the coats lying within it. A large amount of inflammatory connective tissue has developed around the base of the diverticulum. The distal end of the pocket contained a small,

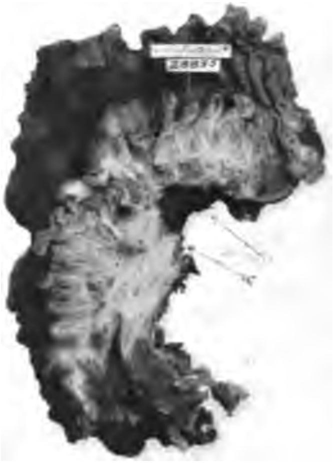

Fig. 146.—Carcinoma on diverticulitis of sigmoid. The same specimen and technic as Fig. 145. The arrows point to two diverticula just in the edge of the carcinoma. Much of the connective-tissue adhesions have been torn away, as is shown by the gap in which the arrows are placed. × ½ diameter.

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* Loc. cit.

dark, fecal concretion when it was opened. This specimen is particularly interesting in that it shows various stages in the destruction of previously formed diverticula by a carcinoma developing thereon. The abundant connective tissue formed in the wall of the sigmoid about the outer extremities of the diverticula was, no doubt, the result of a peridiverticulitis, which long preceded the carcinoma. It is, of course, impossible to say whether the chronic irritative process was the only etiologic factor in the development of the malignant growth. The conditions, however, would seem to be somewhat analogous to those in the stomach when a chronic ulcer has become the base of a developing carcinoma, a process which pathologists and surgeons are now coming to recognize as the usual association in gastric carcinoma. It would seem important that we go over most carefully all carcinomata of the colon for remains of diverticula. There is no doubt that these anomalies are much more numerous than we have hitherto supposed, and their presence may account in some measure for the relative frequency of carcinoma of the colon as compared with that of the small intestine. Difficulty in determining their presence is due to the fact that most cases of carcinoma coming to operation or autopsy are so far advanced that evidence of preëxisting diverticula may have been destroyed in the necrotic center of the tumor. Certain specimens of colon carcinoma which I have examined recently strongly suggested the presence of diverticula, but it was impossible to determine their exact etiologic relationship owing to the mentioned fact.

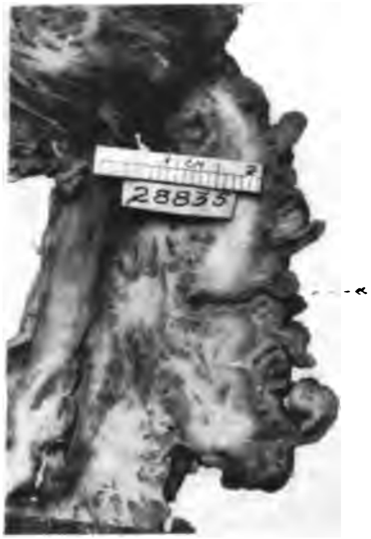

Fig. 147.—Carcinoma on diverticulitis of sigmoid. The same specimen and technic as Fig. 145. The arrow points to the diverticulum lying completely outside the carcinoma. × $1\frac{1}{10}$ diameters.

DIVERTICULA OF THE LOWER BOWEL: THEIR DEVELOPMENT AND RELATIONSHIP TO CARCINOMA*

By LOUIS BLANCHARD WILSON

Up to the present date—December 1, 1910†—15 cases of diverticula of the lower bowel (1 of the cecum, 12 of the sigmoid, and 2 of the rectum) have been operated upon at the Mayo clinic, St. Mary's Hospital. Four of these cases have proved to be carcinoma apparently arising upon diverticula. In view of the frequency of carcinoma of this portion of the alimentary canal it is worth our while to inquire whether any pathologic relationship‡ exists between the two lesions, *i. e.*, diverticulitis and carcinoma.

It has previously been abundantly demonstrated§ that a very high percentage of gastric carcinomata have their origin in islets of epithelium which have been segregated by scar tissue around the bases of gastric ulcers. Likewise, there is strong presumptive evidence|| that primary carcinomata of the tip of the appendix arise in epithelium which has been segregated by obliteration of the lumen of that organ. Is a similar segregation of epithelium present in diverticula of the lower bowel, and, if so, may it furnish the favorable conditions for the development of carcinomata?

Of our 15 cases, 9 were males and 6 females. The oldest patient was seventy-three years of age, and the youngest forty-one years of

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* Reprinted from "Annals of Surgery," February, 1911.

† Originally read before the Richmond Academy of Medicine, Oct. 25, 1910.

‡ Our cases will be herein presented from the pathologic standpoint only, a consideration of their clinical aspects being now in preparation by Dr. H. Z. Giffin.

§ Wilson and MacCarty: "Am. Jour. Med. Sci.," Dec., 1909, vol. 138, pp. 846–852.

|| Wilson: "Jour. Am. Med. Assoc.," Sept. 10, 1910, vol. lv, pp. 921–923; MacCarty: Ibid., Aug. 6, 1910, vol. lv, pp. 488–491.

age, with an average of fifty-five years. It will thus be seen that all of the patients were in the cancer-bearing period. It is also worthy of note that no case of diverticulitis has been found except in adults. The average duration of symptoms was two and one-half years; the longest period nine years, and the shortest three months. Four of the cases had carcinoma associated with diverticulitis and were clinically diagnosed carcinoma. Of the remaining 11 cases (diverticulitis or peridiverticulitis only) 5 gave symptoms which warranted a clinical diagnosis of carcinoma. One was diagnosed clinically "ovarian tumor," one "rectal tumor," one "pelvic tumor," one "pelvic peritonitis," one no clinical diagnosis (autopsy), and one was correctly diagnosed diverticulitis of the sigmoid. This record indicates not only the general character of the symptoms, but also the extreme difficulty of differentiating clinically simple diverticulitis from carcinoma following diverticulitis, or from primary carcinoma.

The probable cause of diverticula of the colon has been thoroughly discussed in recent literature, summaries of which will be found in articles by Mayo, Wilson, and Giffin,* Giffin and Wilson,† Barbat,‡ Abbott,§ and Hartwell and Cecil.‖ It may be stated briefly that diverticula of the lower bowel, while frequently following the course of vessels, probably owe their origin more to congenital weakness of the circumferential muscularis than to any other factor. That they so rarely develop and show inflammatory changes in the young may be due to the fact that the pressure of chronic constipation seems an important element in their development.

It is difficult to say whether or not all of the diverticula are initially true herniæ,—*i. e.*, contain all of the coats of the viscus,—and later become false through their mode of development, as is the opinion of Hartwell and Cecil.* Certainly we have found many colons so defective in both circumferential and longitudinal fibers that, with any considerable pocketing of the wall, many areas would have exhibited no muscular coat. In any case it is certain that as diverticula develop their coats become thinned to such an extent that the muscularis, if ever present, becomes imperceptible. This thinning of the walls, particularly of the distal portions, is so great that one can readily understand how there may be escape of the bacterial contents of the colon into the subserosa without actual rupture of the mucosa and submucosa. In several diverticula in our cases this escape of bacterial irritants seems to have taken place without the epithelium within the hernia showing any inflammatory changes whatever. (See Fig. 148.) Just outside the submucosa and within the fat of the subserosa is a diffuse infiltration with leukocytes, accompanied in some instances with marked increase of fibrous tissue. (See Figs. 149 and 150.) At the same time the mucosa in the tip of the diverticulum appears to be perfectly normal. (See Fig. 151.) Especially is this so if the lumen of the diverticulum freely opens into the bowel. (See Fig. 156, lower half.) This is the condition which I have previously described† as *peridiverticulitis*. It is one which it seems to me is important to recognize, since any symptoms arising from such an inflammation will be initially present in the peritoneum, and not in the colon or diverticulum itself. Of course, as an inflammatory tumor-mass thus develops in the peritoneal fat close to the bowel, symptoms of obstruction may arise. (See Fig. 159.) It is possible that a more careful study of this condition of peridiverticulitis may lead to the recognition of symptoms which will aid in the earlier diagnosis of diverticula.

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* Mayo, Wilson and Giffin: "Surg., Gyn. and Obst.," July, 1907, vol. v, pp. 8–15; "Trans. Amer. Surg. Assoc.," 1907, pp. 240–244.

† Giffin and Wilson: "Amer. Jour. Med. Sci.," Nov., 1909, vol. 138, pp. 661–666.

‡ Barbat: "Surg., Gyn. and Obst.," March, 1910, vol. x, pp. 295–299.

§ Abbott: "Jour. Minnesota State Med. Assoc.," March, 1910, vol. xxx, pp. 118–119.

‖ Hartwell and Cecil: "Am. Jour. Med. Sci.," Aug., 1910, vol. cxl, pp. 174–203.

Whenever a diverticulum becomes impacted with feces an inflammatory reaction of greater or less extent is set up within it. (See Figs. 154 and 155.) When, in addition to such impaction, there exists a greater or less occlusion of the lumen of the diverticulum, the inflammatory process is proportionately increased.

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* Hartwell and Cecil: Loc. cit.

† Loc. cit., Ref. No. 5, p. 9.

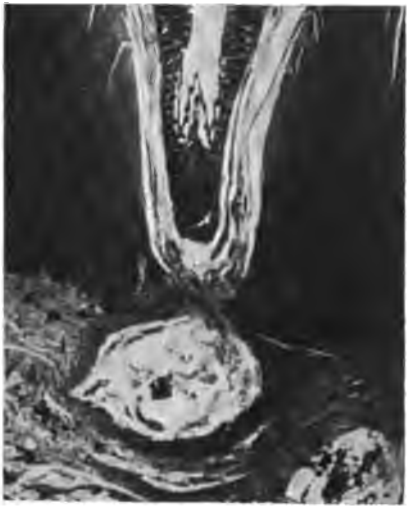

Fig. 148.—Case 4 (19305). × 10 diam. Longitudinal section through tip of diverticulum passing through muscular coats of sigmoid. The diverticulum has no constriction of its lumen, contains no fecal mass, and has no inflammation in its walls (mucosa and submucosa). Within the fat tissue just beyond the outer end of the diverticulum, however, is a very marked inflammation.

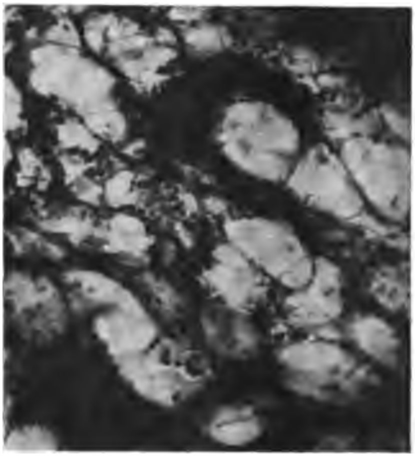

Fig. 149.—Case 4 (19305). × 200 diam. Fatty tissue from beyond end of diverticulum shown in Fig. 148. Note infiltration with leukocytes and increase of fibrous connective tissue the result of chronic inflammation.

(See Figs. 156 and 157.) Many diverticula have globular extremities with lumina which are either very narrow or completely closed off from the lumen of the gut. The mucosa in diverticula of this type is always markedly thinned or entirely absent at the narrowed portions of the lumina, while within the tip it is either degenerating and disintegrating or shows low-grade proliferating changes. (See Figs. 157 and Fig. 152.) These two types of change in the more or less completely segregated epithelium of the tip of the diverticulum are parallel in all respects with the cell changes which occur in masses of epithelium segregated about the base of the gastric ulcer. In other words, it appears that if the segregated epithelium has its blood-supply

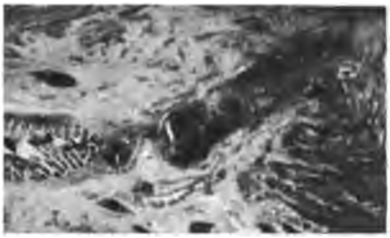

Fig. 150.—Case 2 (16736). × 7 diam. Longitudinal section through tip of a diverticulum from another case, similar to that shown in Fig. 148, but with large amount of fibrous connective tissue *around* the diverticulum in which the mucosa is normal. This specimen contained a large number of diverticula with inflammation only *around* most of them and presented symptoms leading to a clinical diagnosis of carcinoma.

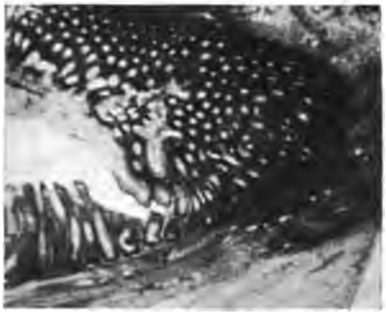

Fig. 151.—Case 12 (36504). × 15 diam. Longitudinal section of tip of diverticulum similar to preceding but of slightly higher magnification. The sections shown above illustrate what is meant by *peridiverticulitis* as distinguished from *diverticulitis*.

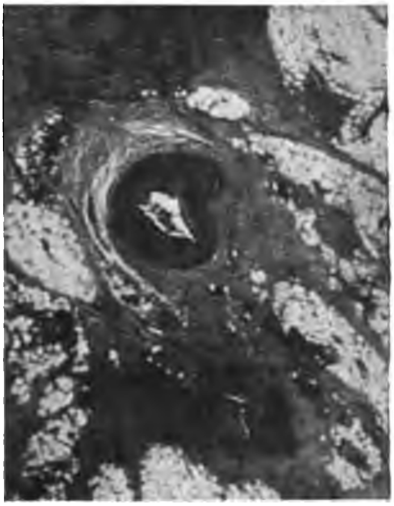

Fig. 152.—Case 7 (28835). × 10 diam. Transverse section of tip of diverticulum, in which the lumen was obliterated proximal to the point shown. The epithelium is here proliferating, but has not invaded its basement membrane. The specimen contained one diverticulum with fairly normal mucosa in its tip (see Fig. 155) and others almost obliterated by carcinoma (see Fig 160).

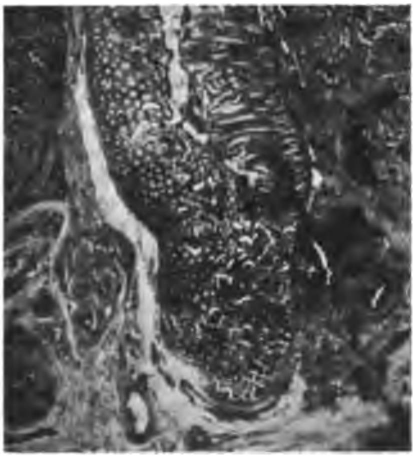

Fig. 153.—Case 6 (21699). × 10 diam. Longitudinal section of diverticulum within the wall of which is well-developed carcinoma. The gross appearance of this specimen is shown in Fig. 161.

materially reduced it degenerates and disintegrates. If, on the other hand, its blood-supply is not materially interfered with, it proliferates. This proliferation usually takes the form only of an increase in the number and size of the cells without any invasion of the basic connective tissue.

Fig. 154.—Case 15 (38021). × 1 diam. Two excised diverticula of the sigmoid (considerably shrunken by fixation). The one to the left still contains its fecal concretion. An inflammatory tumor-mass surrounded the diverticula. This was palpable clinically and led to a diagnosis of carcinoma (patient's age, seventy-three years) by several skilful diagnosticians.

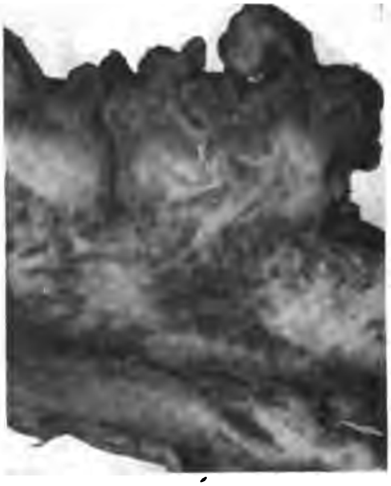

Fig. 155.—Case 7 (28835). × 2 diam. Clear diverticulum in case of carcinoma of the sigmoid, shown in Fig. 160.

It seems to be but a very short step, indeed, from such an epithelial proliferation crowding the entire diverticulum, to the infiltration of its walls, thus forming a histologic picture which must be diagnosed as carcinoma. (See Fig. 153.)

Four of our cases of diverticulitis have well advanced carcinomata developed on diverticula, though the latter are still unmistakable. Unfortunately we have found no very early carcinoma, and must confine our observations to the recently developing portions of old carcinomata in the cases at hand. In each of these, however, there are either diverticula which contain no carcinoma or diverticula which have only a very small portion of their walls carcinomatous. (See Case 7, Figs. 152, 155, and 160, and Case 6, Figs. 153 and 161.) In all three of these thus there seems to be little doubt but that the carcinomata have developed on previously existing diverticula, and to have arisen therein from the epithelium which was previously segregated by inflammatory tissue.

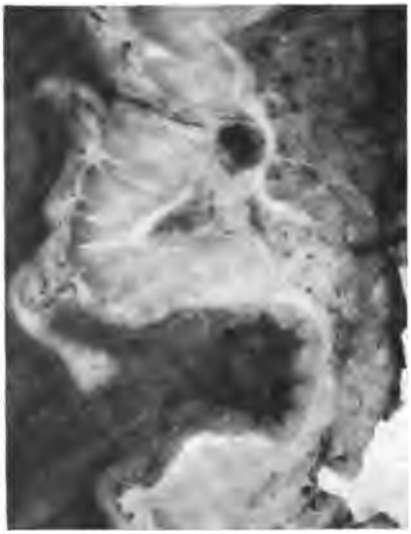

Fig. 156.—Case 4 (19305). × 2½ diam. Two diverticula of sigmoid. In the lower diverticulum the lumen is wide open and there is little inflammation either within or around it. In the upper the lumen is much constricted, a fecal mass lies in the pouched tip, and the mucosa and the surrounding fatty tissue both show marked inflammatory changes.

The probable percentage relationship of carcinomata of the cecum, sigmoid, and rectum to previously existing diverticula can at present only be conjectured. I am convinced that a great many cases, however, do so arise. Further, it seems probable that many cases of carcinoma of these areas which still contain unmistakable remains of diverticula have in the past been overlooked by surgeons and pathologists. The best time for the discovery of divertícular remains in carcinomata of the colon is immediately after the removal of the tissue from the body. If a glass probe with a bulbous point 1 mm. or less in diameter be used very gently in the large pits of the cauliflower surface of a freshly removed carcinoma which is not badly ulcerated, there is a fair chance of discovering any existing diverticula without destroying their mucosa. (See Fig. 158.) When diverticula are suggested by the probe slipping deeply into the tumor, they may be more perfectly demonstrated by slicing the tumor mass into thin layers parallel with the surface of the bowel and beginning on the peritoneal side. (See Figs. 162 and 163.) This method may also be employed with good effect in hardened specimens, though it will here require the utmost care to determine the presence of small-calibered diverticula. When a diverticulum is thus un-

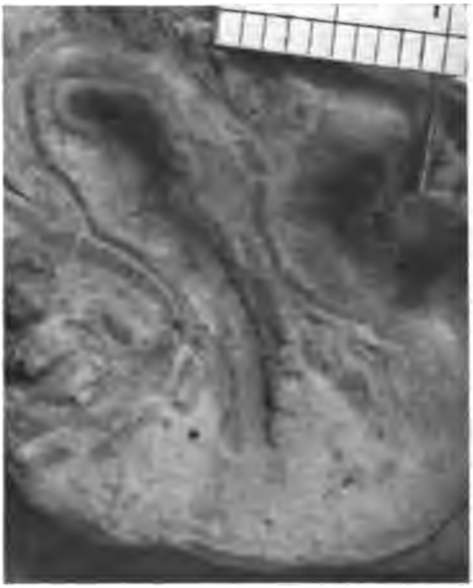

Fig. 157.—Case 1 (19035). × 3½ diam. Diverticulum with lumen completely obliterated. Epithelium of tip proliferating.

mistakably demonstrated, it is best studied by a section parallel with its lumen and with the long diameter of the bowel. The adoption of some such method of examination as above indicated

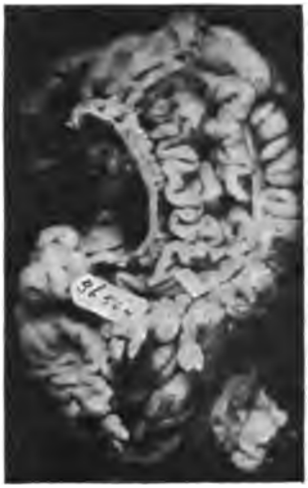

Fig. 158.—Case 12 (36504). × ⅓ diam. Sigmoid containing two diverticula which are indicated by rubber-covered glass probes. Specimen shows the difficulty of finding the evidence of diverticula with the sigmoidoscope.

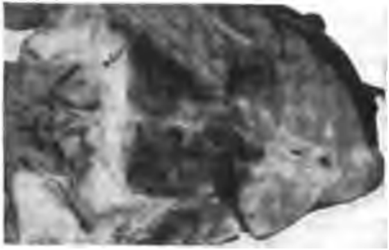

Fig. 159.—Case 14 (37503). × 1½ diam. Transverse section through wall of sigmoid showing diverticulum (at left) and large inflammatory mass external to it.

as a routine examination, especially of fresh tissues, will, I believe, undoubtedly result in the discovery of diverticular remains in a very large percentage of relatively recently developed carcinomata of the cecum, sigmoid, and rectum, and it seems probable that

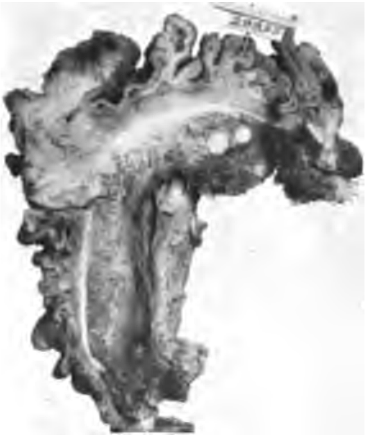

Fig. 160.—Case 7 (28835). × ½ diam. Longitudinal section through sigmoidal wall showing carcinoma containing remains of diverticulum. See also Fig. 152 and Fig. 155, for sections of other diverticula from same case.

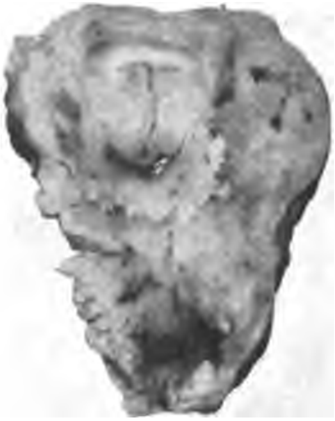

Fig. 161.—Case 6 (21699). × ⅔ diam. Transverse section of sigmoid showing gross appearance of carcinoma mass and its contained diverticulum which is shown magnified in Fig. 153.

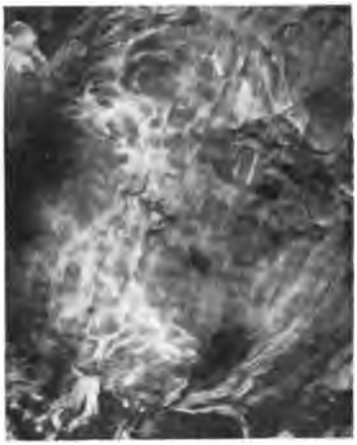

Fig. 162.—Case 10 (35351). × $\frac{2}{3}$ diam. Section parallel with and close to outer surface of tumor-mass in case of carcinoma of the rectum. The transverse sections of the tips of two diverticula are seen close together near the center of the photograph. The picture illustrates the plan suggested in the text for searching for diverticula in carcinomata of the lower bowel.

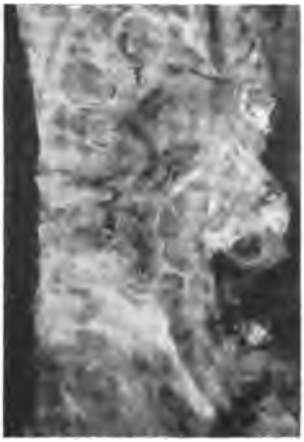

Fig. 163.—Case 10 (35351). × $\frac{2}{3}$ diam. Longitudinal section through wall of rectum at right angles to the section shown in Fig. 162 and opening longitudinally, for a considerable portion of their length, the two diverticula shown in Fig. 162. At the right is seen in section the large "cauliflower" carcinoma which had its origin within the diverticula, and which, as it developed, so distorted and filled their lumina that their openings were missed when probing from the mucosal side of the tumor.

before very long some one will have the pleasure of discovering a carcinoma in a very early stage of development from the segregated mucosa of a diverticulum. In thus calling attention to the importance of recognizing segregated epithelium as a point of least resistance for the development of carcinomata, I wish to disclaim any intention to eliminate other agents as essential etiologic factors in the genesis of tumors.

Summary.—1. Fifteen cases of diverticula of the lower bowel have been studied to date (December 1, 1910) in St. Mary's Hospital.

2. Three of these were cases of *peridiverticulitis.* In these the inflammation did not involve the mucosa. Its presence in the peridiverticular fat was apparently due to leakage through the thin-walled diverticula—a condition similar to that met with in old umbilical herniæ. Their symptoms were those of peritonitis or obstruction from pressure.

3. In four cases carcinomata had developed in the diverticula; probably from epithelium segregated by chronic inflammation.

A METHOD OF ANASTOMOSIS BETWEEN SIGMOID AND RECTUM*

BY DONALD C. BALFOUR

The inaccessibility of tumors of the lower sigmoid at or near the junction of rectum is attested by the unsatisfactory results following the usual methods of operating on this class of cases. Resection of the growth with an end-to-end anastomosis has always been attended by a high mortality: a permanent colostomy renders the patient a nuisance to himself and friends, at least for a time; and any attempt to join the cut end of the proximal sigmoid to the sphincter ani means the unnecessary sacrifice of the rectum. The following method of dealing with such cases has been employed during the past three years at St. Mary's Hospital by W. J. Mayo, with satisfaction.†

For some years it has been the practice here when the lower sigmoid has been accidentally injured, especially where the bowel wall has been infiltrated with inflammatory products, to assist the closure of the intestinal opening by the use of a tube support. A ¾-inch rubber tube with a lateral eye near the extremity (to permit the escape of gases should the end become obstructed) is passed through the anus and rectum up beyond the site of operation, and there anchored by a catgut stitch. This served so well to carry off the intestinal products and proved to be such an admirable splint for the sutured bowel that the idea was suggested of using the tube following extensive resection of the sigmoid. The successive steps in the operation can be briefly tabulated as follows:

1. The patient is placed in a high Trendelenburg position and a long median incision is made between umbilicus and pubes.

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* Reprinted from "Annals of Surgery," Feb., 1910.

† "Montreal Med. Jour.," Oct., 1909.

2. The intestines are carefully packed off above, leaving only the lower sigmoid exposed in the pelvis.

3. Liberation of the affected portion of the bowel is effected by lateral incisions through the peritoneum, especially through the outer leaf of the sigmoid, and a semilunar incision is made along the base of the bladder connecting the two lateral incisions.

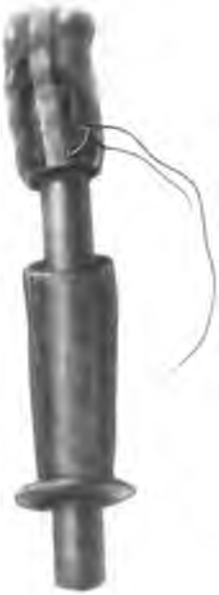

Fig. 164.—Showing tube introduced through rectum up into proximal sigmoid, and placing of catgut suture.

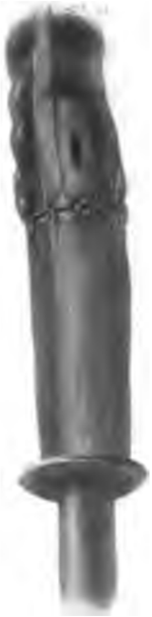

Fig. 165.—Showing tube used for bringing the two ends into apposition and first row of sutures placed.

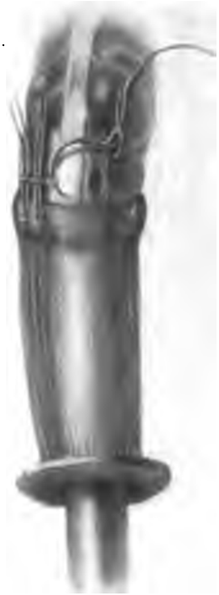

Fig. 166.—Showing intussusception accomplished and outer row of sutures placed.

4. Careful dissection of all the fat and glands as high as the abdominal aorta, the hollow of the sacrum being swept clean.

5. Ligation of the inferior mesenteric and middle sacral arteries at proper points.

6. Two pairs of forceps are clamped on the bowel at a suitable distance below the tumor and two on the proximal side; the neces-

sary amount of sigmoid with the tumor excised, and the cut ends sterilized.

7. A ¾-inch rubber tube is passed into the lower segment of bowel until the end protrudes through the anus; the upper end with lateral eye is inserted into the proximal end of the sigmoid to a distance of some 3 inches. It is here secured by a transverse catgut stitch ½ inch above cut end of the intestine (Fig. 164).

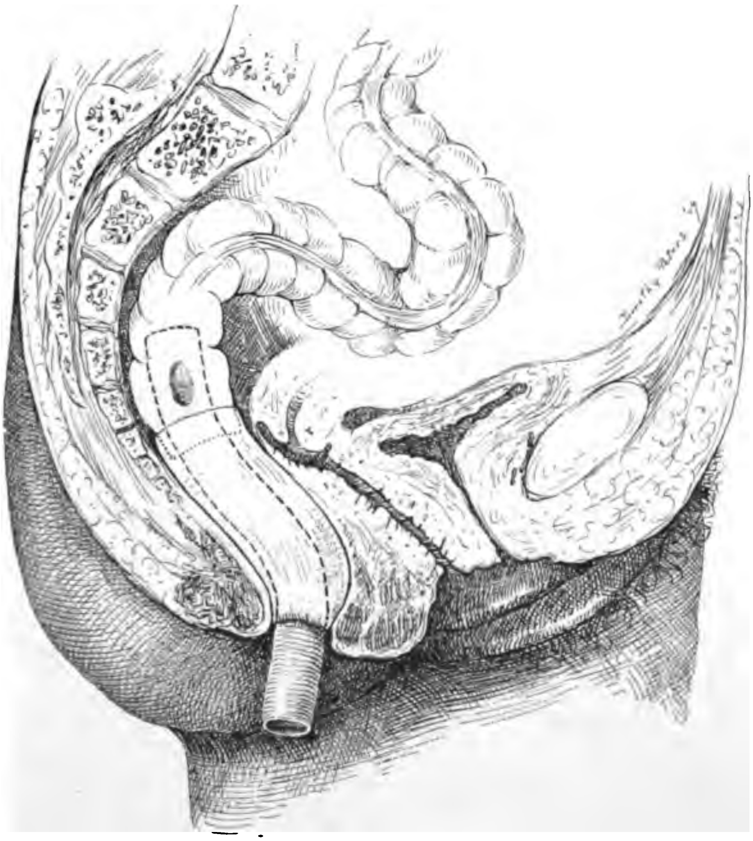

Fig. 167.—Profile drawing of median section of pelvis showing completed anastomosis.

8. Traction is made by an assistant upon the end of tube projecting from the rectum, until the cut ends of the bowel meet, and

the anastomosis is made by interrupted through-and-through chromic catgut sutures with careful coaptation of the mucous membranes (Fig. 165).

9. Traction is again made upon the tube sufficient to accomplish a half-inch intussusception, this being aided by a few forceps on the distal fragment to steady it, and a second row of seromuscular sutures is inserted. Sometimes the parts are so deeply situated that the second row cannot be well placed, but the ultimate result has been good nevertheless (Fig. 166).

10. The defect in the peritoneum behind is remedied by sliding the peritoneum and suturing, and finally the omentum is drawn down over the anastomosis, and if necessary secured by a catgut suture.

11. The abdominal wound is closed in the usual way, drainage being provided for, as a rule, by two wicks carried down on each side of the anastomosis into the hollow of the sacrum, and brought out the lower part of the abdominal incision. The rubber rectal tube remains in position about six days, until the catgut suture is absorbed. The abdominal drains are loosened on the fourth to the sixth day, but usually not removed for a week because a temporary fistula sometimes occurs.

REMOVAL OF THE RECTUM FOR CANCER: STATISTICAL REPORT OF 120 CASES*

By WILLIAM J. MAYO

It is my purpose to review in this paper 120 resections of the rectum for cancer which were done in St. Mary's Hospital between April 21, 1897, and December 31, 1909. Operations previous to this have been excluded because the data were insufficient from which to make the desired investigation.

The number of cases is not large, but as the results have been obtained under nearly identical conditions and by various methods of operation, the material furnishes some information.

Total number of resections of the rectum for cancer in St. Mary's Hospital (C. H. and W. J. Mayo) from April 21, 1897, to December 31, 1909	120
Males	63
Females	57
Age of oldest patient	81
Age of youngest patient	27
Average age	52.12

Perineal route	Perineal resection	11	38
	Quénu-Tuttle	22	
	Harrison Cripps	5	
Posterior route	Kraske: modified	51	56
	Resection continuity	5	
Abdominal combined	Combined	20	26
	Combined with permanent colostomy	6	
Total			120

Operative Mortality.—This includes all cases dying in the Hospital following operation, without regard to cause or length of time. Three deaths occurred from exhaustion more than four weeks after operation, one from pulmonary embolus, and one from apoplexy.

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* Read before the American Surgical Association, May 5, 1910. (Reprinted from "Annals of Surgery," June, 1910.)

Total number	120
Mortality (per cent. 16)	20
Total number during 1908–09	44
Mortality (per cent. 9)	4

Amount of bowel removed	Lower rectum	5
	Middle rectum	5
	Entire rectum	75
	Entire rectum and part of sigmoid	32
	Entire rectum, part of sigmoid, uterus, ovaries, tubes and part of vagina	1
	Rectum and prostate	2
Total		120

PATHOLOGIC REPORT

Carcinoma	119
Sarcoma	1
Total	120

RESULT

Operated upon more than five years ago		32
Present condition known		17
Alive and well	2 abdominal (1 alive 9¾ years; 1 over 5 years) 2 perineal (1 alive over 9 years; 1 over 7¾ years)	4

Operated upon more than four years ago	41
Present condition known	26
Alive and well (3 abdominal, 3 perineal, 2 posterior)	8

Operated upon more than three years ago	60
Present condition known	43
Alive and well (4 abdominal, 3 perineal, 6 posterior)	13

Operated upon more than two years ago	82
Present condition known	63
Alive and well	26

Operated upon more than one year ago	102
Present condition known	82
Alive and well	36

Operated upon less than one year ago	18

I am indebted to E. C. Moore for his painstaking investigation in compiling the data as summarized above.

It is an unfortunate fact that in the majority of instances cancer of the rectum is not recognized in time to obtain a radical cure. When one considers that such tumors are, as a rule, within easy reach of the examining finger, and that they may readily be inspected with the proctoscope, it indicates a lamentable carelessness on the part of the medical profession and gives point to the saying that most errors in diagnosis are due to careless methods of examination rather than to lack of knowledge. We were also impressed with the fact that nearly 10 per cent. of the cases subjected by us to resection had been recently operated upon for piles, or had been subjected to a futile dilatation with bougies for supposed stricture.

Excluding the stomach, the rectum is the most frequent seat of cancer of the gastro-intestinal tract. The relative proportions are shown in the following table:

TOTAL NUMBER OF CASES OF CARCINOMA OF THE GASTRO-INTESTINAL TRACT SEEN IN THE CLINIC AT ST. MARY'S HOSPITAL DURING THE YEARS 1908–09

	Radical Operation	Palliative Operation	Exploratory Operation	Inoperable	Total
Stomach	78	45	74	191	387
Small intestine	..	2	1	..	3
Large intestine	40	15	8	6	69
Rectum	44	..	3	45	92
Total	..	..	..	..	551

The anatomic situation of the rectum is such that the technical difficulties of a radical operation are very great, and the means of approach, especially to the middle and upper portions, are indirect and difficult. The main arterial supply of the rectum is derived from the inferior mesenteric artery, which, after it crosses the left common iliac, becomes the superior rectal artery. At the upper border of the third sacral vertebra, which marks the beginning of the true rectum, the rectal artery divides into the right and left hemorrhoidals. The middle hemorrhoidal arteries arise separately or jointly with the vesical arteries from the anterior division of the internal iliac arteries, and are of much less importance. The inferior hemorrhoidal arteries are derived from the internal pudic and are of still less importance. The lymphatics follow the blood-supply upward to the deep lumbar chain of glands. The lower inch and a quarter of the rectum is derived from the proctodeum, and on this account the lymphatics in the inguinal region are liable to be infected in rectal carcinoma which involves the anus.

While it cannot be said that too much attention has been paid to the lymphatics in carcinoma of the rectum, it can be truthfully asserted that too little attention has been given to the local extent of the disease. In our experience inoperable conditions, as a rule, have been due to hopeless local extension rather than to lymphatic metastasis. I could go further and say that I have seen more cases in which embolic carcinoma of the liver has been the contraindication to excision of a locally removable disease than has irremovable glandular metastasis.

Hartwell collected records of fifty patients operated upon by seventeen New York surgeons, and found that local return was the rule in all the cases which were not cured. It is evident that more extensive and perfect methods are needed of removing actually involved structures; and it is just here that the greatest difficulty is encountered, especially in the male. The bladder, prostate, urethra, and seminal vesicles seriously limit the extent to which dissection can be carried, which accounts for the higher mortality and smaller percentage of cures in the male as contrasted with the female.

Of the 120 cases, 63 were males with 11 deaths, and 57 females with 9 deaths. Of the 60 cases operated upon more than three years ago, there were 29 males and 31 females. Of the 13 alive and well, 5 were males and 8 females.

Sepsis was the cause of the highest percentage of operative mortality. The rectum contains the most virulent organisms at all times. As pointed out by Hochenegg, the feces in the fluid state are not only filled with bacteria, but are mechanically difficult to control, and he therefore advises clearing out the intestinal tract at least forty-eight hours before operation, allowing the intervening time to enable the intestines to become quiet. For the same reason Kammerer and others advise a preliminary and usually a permanent colostomy in order that the lower fragment may be cleansed and freed from fecal contamination before the radical operation, which is made one or two weeks later.

A great many surgeons practise closure of the anus with circular sutures and take every precaution to prevent leakage during operation. Peck has made a valuable contribution to the technic in advising temporary closure of the proximal bowel after operation. The closed end of the stump is fastened into the anal space and left closed for forty-eight hours or more until union takes place. In some of our cases union was primary, two patients leaving the hospital three weeks after extensive resection with completely healed wounds and with moderate muscular control.

If catharsis had not been used for at least forty-eight hours before operation it was surprising how long complete obstruction could be maintained without great discomfort to a patient who had been kept on a diet of albumin-water, broths, etc. In one case, a woman, we were able to maintain complete closure for seven days, and complete closure for three, four, and five days was not uncommon following operation.

The question of interference with function after resection is very important and it is a serious drawback to the majority of methods in use. For carcinoma above the middle rectum, Blake prefers a permanent colostomy. His reasons for this are based upon sound principles and have the merit of enabling the most radical treatment of the local disease. Weir, Maunsell, Tuttle and others prefer to follow some modification of the Quénu method, which, in the high cases at least, does not require a sacrifice of the group of muscles which give control, and even if this control is not perfect it is much more satisfactory than a permanent colostomy. It frequently happens that the muscular control is inefficient and unsatisfactory, and, especially as contrasted with the sacral anus, a permanent colostomy is preferable. We have always made a careful statement of facts and conditions to the patients, obtaining their consent to whatever might appear necessary at the time of operation, and after the removal of the growth we have made the best disposition possible for function.

The 120 cases have been divided into three groups, which have been classified according to the means of approach into—(1) perineal operations; (2) posterior operations of the Kraske type; (3) abdominal operations of the combined type. Up to the present time we have not chosen any one operation to which we unhesitatingly give preference in all cases. In making a choice of operations we are influenced in individual cases by the situation of the tumor, age and general health of the patient, and especially as to whether there is a great quantity of adipose tissue. The abdominal method in the very obese, especially males, is attended by a considerable mortality, much higher than with the employment of either the perineal or the posterior route.

Perineal Operation.—In doing the perineal operation we have found the exaggerated lithotomy position the most useful. Cancers which lie in the muscular canal of Symington, *i. e.*, lower 1¼ inches of the rectum, are most satisfactorily dealt with by the Harrison Cripps operation. The distinguished orginator of the method has reported a large number of cases in which it has been employed in operating upon cancers of the rectum in various situations, and has shown good results. In our experience, which has been limited to five cases within the last three years, the functional result was extraordinarily good, considering that the entire muscular apparatus was removed in all of them. The essential idea as regards the operation is the removal of the rectum to a point well above the seat of the disease including the muscles, fat, and surrounding tissue, making no attempt to draw the end of the bowel down. If the peritoneum is opened during the operation, it is closed at once. Some time in the third week dilatation with bougies is commenced and kept up for a few weeks. The sigmoid trap is fortunately not disturbed and the long cicatricial canal which is formed gives something approaching control.

For cancers above the levator ani muscle, but within easy reach of the examining finger, the perineal operation of the Quénu-Tuttle type has given us the best satisfaction. Patients who were in wretched physical condition from ulceration and hemorrhage have, as a rule, made good recovery after this method, and often a very fair degree of muscular control has been obtained. In the female this operation may be applied to high tumors, as the uterus and vagina protect the bladder, ureters, etc. In the male, tumors which lie in the middle and upper part of the rectum are so closely associated with the bladder, prostate, seminal vesicles, and ureters that the posterior route enables the dissection to proceed under better inspection than with the perineal method.

The Quénu-Tuttle operation is particularly applicable to those tumors which lie in the middle rectum above the levator ani muscle. The anus is closed with a purse-string suture and an incision made through the muscle plane which begins at the anus, cutting through the external sphincter and extending to the coccyx, which is removed if more room is needed. With the fingers the entire hollow of the sacrum is swept free from glands and fat and a gauze pack introduced temporarily. The levator ani and associated muscles are now cut free from the rectum, and the rectum itself freed from its anterior muscular association and drawn backward. The dissection is deepened through the perineum anteriorly until the peritoneum is reached and opened. In the male, during this anterior dissection, a sound should be kept in the urethra to prevent injury. A gauze pack is now placed in the peritoneal cavity and the rectum well freed anteriorly and posteriorly until it hangs by a lateral band on each side, much as the uterus is held by the broad ligaments. Heavy crushing clamps are now placed upon each side grasping these lateral attachments close to the pelvic wall. The rectum is cut free and drawn down, and by making its lateral peritoneal reflections taut and dividing them, it is not usually difficult to draw out the entire rectum and part of the sigmoid with all of the glands and fat attached. The lateral clamps are removed, the bleeding vessels ligated, and the peritoneal cavity closed anteriorly by a few catgut sutures, and after tying the proximal sigmoid the rectum is cut away, the stump sterilized with the actual cautery and drawn down into the muscular space. The sigmoid should be sufficiently free from tension to allow it to take the natural curve of the sacrum, as recommended by Hartmann, and the closed stump allowed to project at least 1 inch beyond the anal margin. The stump is rather loosely attached to the muscles, which are not completely closed posteriorly.

Posterior Operation.—In the posterior operation we have practically given up removing any part of the sacrum. If the coccyx is removed, an incision along the side of the sacrum gives nearly as good exposure and much more rapid healing of the wound following operation. We have found it most satisfactory to place the patient on the table face downward in the Trendelenburg position. In this posture hemorrhage is much diminished because of the pelvic elevation, and when the peritoneal cavity is opened the pelvis is automatically freed of intestines and a splendid view of the operative field afforded. As mentioned already, we seldom do this operation except in the male. Kammerer makes a preliminary permanent iliac colostomy, and ten to fourteen days later he dissects the rectum by the posterior route, closing the proximal end of the bowel completely by suture. As contrasted with the sacral anus, this gives the better functional result.

Combined Abdominal Operation.—This is undoubtedly the operation of choice in the large majority of cases of cancer in the upper part of the rectum, and also in selected cases of low rectal cancers. This operation has the great advantage of enabling proper examination of the upper limits of the growth and for lymphatic metastasis, and especially to note whether the liver is free from disease. However, in the very fleshy subject, especially the male, it is an operation attended with considerable mortality. Undoubtedly as increased experience and improved technic make the operation easier and safer, it will become the method of choice. At the present time, however, with the greater number of patients reaching us at a stage of the disease when cure is doubtful under any treatment, the perineal and posterior routes, being safer, have a field of usefulness. It will be noted in our statistics that the perineal and posterior routes have furnished as high percentage of three-, four-, and five-year cures with a lower mortality than the combined abdominal route. It is more than ten years since we first began to use the combined abdominal method. In twenty of our cases the operation was completed by drawing the stump of the sigmoid down into the anal space. In six cases a permanent colostomy was done. I believe our mortality would have been smaller and the functional results just as good had we made permanent colostomy oftener.

Hartmann has recently called attention to the work of Sudeck and Archibald, showing the anastomotic loop between the sigmoid arteries and the superior rectal. Hartmann demonstrated by dissections that this vascular anastomosis lies just below the promontory of the sacrum. He emphasizes the fact that division of the inferior mesenteric artery just above the promontory insures vascularization of the sigmoid so that it may be safely drawn down into the anal space, whereas division of the artery below the point of anastomosis endangers the circulation.

The abdominal route certainly permits better glandular dissection, but the perineal and posterior routes must, in any case, be used for the removal of the actually diseased structures. The abdominal operation is simply one step in the more thorough eradication of the local disease which must be reached from below or behind, and is not a substitute for them.

PELVIC TRANSPLANTATION METASTASIS AS A MEANS OF RECOGNITION OF HOPELESS ABDOMINAL CARCINOMA*

BY DUDLEY W. PALMER

In the treatment of all carcinomata it is quite as necessary to have definite rules for guidance against operation as for operation. It is important to lay stress upon every warning point, as the present necessity for exploration only emphasizes our more or less limited knowledge, and it is our duty to save as many patients as possible from the shock of even a simple operation for exploration, when by a more thorough examination some of them might at once be definitely classified as hopeless.

It is to routine digital examination of the rectum with the patient in the knee-elbow position, and bimanually with the patient in the lithotomy position, that we wish to call particular attention in this paper; and no case of abdominal tumor should be operated upon without such examination. By this means alone we have been able to prove over 6.5 per cent. of upper abdominal carcinoma to be hopeless.

While reviewing the histories of some 435 cases of upper abdominal carcinoma seen in the last twenty months at the Mayo clinic, we were surprised to find so large a percentage of them showing the following positive contraindications to operation. For example, upon examination a small, hard, nodular tumor is found with the clinical history and laboratory findings of carcinoma of the stomach. It is freely movable and apparently mechanically removable. On rectal examination at a point about 3 to 5 inches from the anus along the anterior rectal wall (on what has been termed by George Blumer the "rectal shelf"), above the prostate in the male, and above and behind the uterus in the female, we may find a hard nodular mass distinctly originating within the peritoneal cavity. These may be single or multiple and may vary in size from a small bean to an orange. Sigmoidoscopic examination shows the rectal mucosa uninvolved. This may remain as a distinct neoplasm or may, through a process of infiltration, begin the formation of a crescent-shaped area of cartilaginous hardness that partially surrounds the bowel. We have not seen a case that produced any stricture-like symptoms, nor have we seen one that gave symptoms suggestive of rectal carcinoma. The presence of free fluid in the abdomen often indicates a hopeless condition because it is indicative of a considerable peritoneal irritation and usually actual involvement, but implantation carcinomata are often found before free fluid can be distinguished clinically and before secondary masses can be distinguished through the abdominal wall. It must be borne in mind, however, that negative findings are of no value. One must also be guarded against mistaking for this condition fecal concretions higher up in the sigmoid, and old inflammatory deposits in the pelvis. Tuberculous peritonitis can be differentiated by the "feel" of the mass, its location being more diffuse, taken together with the history of the patient. Blumer cites a case where a small subperitoneal myoma projecting into Douglas' pouch caused some confusion. He also calls attention to the fact that Houston's fold of the rectum is sometimes thickened.

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* Reprinted from "Surg., Gyn. and Obst.," Feb., 1910, pp. 154–156.

Once the peritoneal covering of the primary growth has been broken through, the carcinoma cells are spread in more or less numbers throughout the serous cavity by gravitation, intestinal movements, or the normal circulation of the intraperitoneal fluid. We believe that a fair percentage of these cells will early find their way to the lower part of the cavity, and because of the position of the rectum acting as a shelf, they will in many instances lodge thereon. The tendency to gravitate to the pelvis is more pronounced because most of the patients with upper abdominal carcinoma are able to be about and often do light work.*

The above findings, which are brought out better by the rectal examination than by the vaginal, have been of value also in leading to a positive diagnosis of carcinoma of the stomach in cases where no tumor could be palpated even on distention. They are also, if present, positive proof in the differential diagnosis of carcinoma from that little understood class of cases with a stomach history and laboratory findings typical of carcinoma of the stomach, but in which no cancer is present. Findings of this character will also establish the diagnosis between a well starved ulcer case with considerable tumefaction and a carcinoma case. A few cases have been referred to us as being pelvic. Examination showed findings as described above and directed our attention to a gastric history which the patient had not emphasized, and here we found the primary and important condition.

Several years ago in this clinic, when attention first began to be paid to these pelvic deposits, a few cases were operated upon, the local condition being such as to indicate a radical procedure, but on slipping the hand into the pelvis the peritoneal deposits were found to be definitely carcinomatous. Through correspondence we found, further, that quite a number of patients similarly affected, where operation was refused solely because of the deposits, had died in a few months. As a means to more exact prognosis such deposits demonstrate the life of the patient to be positively limited and to have passed beyond the operative stage,

In the 435 case histories were 307 cases of carcinoma of the stomach, the remainder being of the intestine, pancreas, liver, and gallbladder. In this number 28 showed secondary deposits on the rectal shelf or in the cul-de-sac of Douglas. No secondary deposits were to be palpated through the abdomen, and with two exceptions abdominal fluid was clinically questionable or absent. Of the 28 cases, 4 had palliative operations for obstructive symptoms; 2 of these were pyloric, 1 ileocecal, and 1 of the ascending colon. Of the 19 cases not operated upon, the clinical diagnosis was primary cancer or cancer on ulcer in all but 4, and these were diagnosed carcinoma of the liver, and carcinoma of the upper sigmoid. Regarding sex, our series is at variance with some other reported cases as showing a larger percentage of females, namely, 10 out of 28 cases. The tendency for detached malignant cells to implant themselves upon uterine adnexa was shown by 2 cases of gastric cancer with secondary malignant ovarian tumors found in the same period. A few cases only showed rectal symptoms of increased constipation during the last few months, and 3 showed irritable bladder developing. The constipation could hardly have been attributed to the size of the mass; the irritable bladder might have been due to deposits on the bladder wall.

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* This is contrary to those experiments where shot have been introduced within the peritoneal cavity and are found not to gravitate to the pelvis; nevertheless, the clinical evidence seems to warrant this assumption.

In the series of 435 cases we found 18 cases of supraclavicular gland enlargement. Several glands were subjected to microscopic examination, but the majority of patients were refused operation on the clinical findings alone, the supraclavicular glands being the deciding feature. Only 2 cases showed both supraclavicular and pelvic metastasis. One case showed right-sided, and one right- and left-sided glandular involvement, and the remainder were left-sided only. These do not include a few cases where we were unable to locate the primary focus.

If the number of cases here reported may be taken as a fair average, then the pelvic deposits are of much more value as a means of decision as to the inoperability of a given case than the supraclavicular metastasis, and by means of pelvic and supraclavicular metastasis more than 10 per cent. of the whole shown to be hopeless without exploration. It is only within the last few years that attention has been called to this sign in the current literature by such men as Schnitzler, Kaeppeler, and Kellog, of Germany, G. Gray Turner, of England, and George Blumer, of this country.

Age seems to have little influence as regards whether these warning flags shall be hung in the pelvis or in the shoulder. Both types showed cases in all of the cancer decades.

Summary.—1. Rectal examination is absolutely necessary in all abdominal tumors.

2. Of 435 consecutive cases of carcinoma of the upper abdomen 6.5 per cent. showed pelvic transplantation deposits as the earliest clinical sign of inoperability. Seven and two-tenths of gastric carcinomata had this sign.

3. Fifty-five per cent. more cases were shown to be inoperable through a thorough rectal examination for pelvic metastasis, than because of the presence of supraclavicular gland metastasis.

4. Pelvic metastasis warrants a most unfavorable prognosis as regards life expectancy.

HERNIA

INDICATIONS FOR HERNIOTOMY IN INGUINAL HERNIAS*

By E. S. JUDD

That operation is the safest and most rational treatment of inguinal hernia in the adult is recognized at this time by almost every one. It is true that a truss may be worn satisfactorily in some instances during this period, but the time is almost sure to come when the appliance will not hold, and the hernia will then be much more difficult to cure by operation.

Treatment by injections appears to be not only unsatisfactory, but dangerous. There seem to be two questions regarding the indications for herniotomy that we are not all agreed upon: (1) The time for operation in children, and (2) as regards operation in the old person who is not otherwise entirely well.

Operations for the cure of existing inguinal hernia in children and the reconstruction of the area to prevent recurrence of the condition are not difficult procedures and should be attended with practically no mortality or future trouble. It appears that in all probability the obliteration of the vaginal process of the peritoneum begins at a point near the external abdominal ring. In case the obliteration does not extend to the internal abdominal ring there is still a sac remaining which is a congenital defect, and a viscus descending into the sac constitutes a congenital hernia, in spite of the fact that there is no communication with the tunica vaginalis.

No doubt a very large majority of all inguinal hernias, in children at least, are congenital, and a cure will be brought about only by a complete obliteration of the vaginal process. This can be accomplished in a certain percentage of cases by the rigid and persistent

* Read before the Chicago Medical Society, Dec. 15, 1909. (Reprinted from the "Illinois Med. Jour.," April, 1910.)

wearing of a truss. Just how many patients are cured in this way is difficult to estimate, because some who are all right for a time will suddenly, by an extra effort, force the bowel into the only partially obliterated sac. This may not happen for months, or even until the patient reaches adult life, though when it does occur it is apt to be serious, as it is this type of hernia which so often becomes strangulated.

In reviewing the histories of 15,000 cases of inguinal hernias in adults Coley found that about one-third of them had had hernia in infancy or childhood. Some observers go so far as to say that all inguinal hernias up to the period of middle life are congenital, and almost every one is agreed that a typical acquired hernia is a rare condition.

In a series of nearly 3,000 herniotomies, we have operated upon about 500 patients who were under twenty years of age, and approximately 200 of the number were under five years of age. There has been no mortality following these operations in children and only two relapses. One relapse came in a boy twelve years old, who had a preperitoneal hernia. The protrusion showed as soon as he was allowed to be up, and we believe that it came through a part of the sac that was not properly closed at the first operation. The second relapsing case was a boy nine months old with a very large hernial sac, containing omentum that could not be reduced before operation. A small piece of this had been jammed with a truss, and was removed, the sac ligated high, and the internal oblique muscle and the conjoined tendon sutured to Poupart's ligament anterior to the cord. The relapse came in nine months, and at the second operation we closed by transplanting the cord.

Feeling confident that the operation will be attended by unusually good results, with practically no mortality, and that any other method of treatment, such as wearing a truss, does nothing toward an actual obliteration of the vaginal process, and is, therefore, not a true cure, we believe that the operation should be performed at a time most suitable for the patient and for the parents. The indication for performing herniotomy in the child or infant with an easily reducible and painless inguinal hernia is not because of the inconvenience it gives the child, but because of the trouble and anxiety to the child's mother. If away from the child, she worries constantly, fearing that the truss will work loose or the hernia come down; she will feel that the child must be kept quiet and housed up when he should be out of doors—all of this uneasiness and care for the mother in the hope that the hernia may heal without operation. Suppose it does heal; there are still many chances that it will open again, and at a time much less suitable to have it repaired, and when it will present a much more serious condition.

If the hernia is strangulated, it should, of course, be operated upon at once. If it is incarcerated, increasing in size, or is a source of pain to the child, there will be nothing gained by waiting, no matter at what age the patient comes for examination. Operating upon the child is not as difficult as operating upon the adult. It is seldom necessary to disturb the cord. Free the sac from the cord just outside the external ring and continue the dissection downward to the termination and upward to the internal ring by working through the opening of the external ring. The sac should be ligated as high as possible and allowed to drop back. Great care should be taken to avoid the vas deferens, as it is usually intimately associated with the sac, and in children is frail and easily injured. Having freed the sac at the external ring, it is more convenient to open it at once in order to introduce a finger to aid in the dissection and preservation of the vas, and also to determine whether the obliteration has separated the peritoneal cavity and the tunica vaginalis. In event there is no evidence of obliteration and the hernial sac and tunica vaginalis are one and the same process, it will be necessary to divide this sac near the neck, then continue the dissection of the proximal part to the internal ring, and ligate, saving the distal portion as a tunica vaginalis. It is better to keep this an open sac, as the traumatism of the operation may cause an increase in the amount of fluid, and if the sac is closed a temporary hydrocele might result. This will be avoided by allowing the tunica to close at will.

Having disposed of the sac, the cord is dropped back to its normal position, and in most cases one stitch of chromic catgut approximating the conjoined tendon to Poupart's ligament will suffice. In case the internal oblique and the conjoined tendon are not well developed, a small incision in the aponeurosis of the external oblique in the region of the internal ring, not opening the external ring, will give room to suture the internal oblique to Poupart's ligament, just saving space for the cord structure to pass through. The superficial fascia is closed by fine, plain catgut, which is continued through the skin as a subcuticular stitch. The wound is sealed by covering it with a small piece of absorbent cotton saturated with compound tincture of benzoin. Over this a small piece of gauze is held in place by adhesive tape.

The mother is given the ordinary instructions as to diet and laxatives, and is allowed to take the child from the hospital a few hours after he has recovered from the anesthetic. A little paregoric will relieve the pain of the first night; after that he will require nothing more than ordinary care. There are no stitches to be removed, so that in a few days, when the wound is properly healed, the patient may be taken home.

By far the greatest percentage of relapses following operations for inguinal hernia come after operations upon patients in old age. In our experience, also, the majority of strangulations occur in people past middle life. It is not unusual to see a hernia of fifty years' standing that has always been easily reducible suddenly become strangulated. Before advising operation for old people we should thoroughly examine other conditions. If an old man is obliged to get up several times at night and strain to void urine, we must correct this condition before operating for the hernia or he will be almost sure to bring on a relapse by the constant straining. If the hernial opening is increasing in size and the protrusion constantly creeps outside the truss, the patient is in danger of the hernia strangulating, and the operation should be done, using a local anesthetic if necessary. The relief following the cure of hernia in old people is often much more than just the local condition, and as soon as these patients can get about without the constant worry and dragging, or the pressure of the truss, they will become active and much improved in a general way.

In operating upon old people we have the thin white scar tissue of the internal oblique to close the opening. There frequently is almost an obliteration of the conjoined tendon. The opening is either direct anatomically or has become so from long standing. The relapses we have seen in these cases have come just above the pubic bone; for these reasons we always transplant the cord and close the lowest angle as closely as possible, opening the sheath of the rectus and using that muscle if necessary.

In conclusion: It seems to me (1) that the simplest and most satisfactory way of treating inguinal hernia in children is by operation, and the chief indication for performing it, the trouble and consequent anxiety to the mother in caring for the child in this condition. (2) Herniotomy is the only safe method of treating inguinal hernias in adults. (3) The operation can be done with much better satisfaction and more safety in old people than was formerly believed.

GENITO-URINARY ORGANS

SOME OBSERVATIONS ON THE OPERATION OF ABDOMINAL MYOMECTOMY FOR MYOMATA OF THE UTERUS*

By WILLIAM J. MAYO

Hysteromyomectomy as a method of radical treatment for myomata of the uterus is an operation of recognized value and holds a dignified position among major surgical operations.

For patients over forty years of age hysteromyomectomy is undoubtedly the operation of choice, and after the age of forty-five there will be few exceptions to this choice. Ten per cent. of women who require operation for myomata after they have reached the age of fifty years (Bland-Sutton[1]) will have associated with it malignant disease of the uterus. When we consider that 4 per cent. of all myomata requiring operation are associated with some form of malignant disease, the reasonableness of the radical operation in the fifth and sixth decades is evident.

The pathologic incidence of carcinomata of the body of the uterus, and of the cervix when uncomplicated by myomata, is 15 carcinomata of the cervix to 1 of the body of the uterus (Winter[2]). In association with uterine myomata, the proportion of carcinomata of the cervix is not increased, and occurs in but $\frac{1}{3}$ to $\frac{1}{2}$ of 1 per cent., while carcinomata of the body of the uterus occur in from 2 to 2½ per cent., a disproportionate ratio of nearly 100 to 1.

Carcinoma of the gall-bladder occurs four or five times as often in women as in men, the relation being the same as the relative frequency of gall-stone disease in the two sexes.

Wilson and MacCarty[3] have demonstrated that in 71 per cent. of over 300 resections of the stomach for cancer the disease had its origin in ulcer. We must admit that the chronic irritation of myomata of the uterus stands in the same etiologic relationship to cancer of the corpus uteri that chronic irritation in other parts of the body stands in relation to carcinomata.

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* Reprinted from "Surg., Gyn. and Obst.," Feb., 1911.

We have no positive knowledge as to the cause of cancer, but the influence of chronic irritation in its production is beyond question. It has been pointed out by Keen,[4] and later by Bloodgood,[5] that no cases of carcinomata of the skin have been reported which did not begin in some preëxisting lesion, *e. g.*, moles, warts, heat or sun irritation, syphilitic or tuberculous lesions, or the result of chemical or other traumatism, etc. Clinical and pathologic observations now point quite clearly to the fact that a malignant condition of the concealed epithelial surfaces of the body also arises in some preëxisting lesion.

Sarcomata occur in association with myomata of the uterus in 1½ per cent. of the cases.

Settled as we are in our conviction that, other things being equal, hysterectomy is the wiser procedure after the patient has reached the age of forty, what shall we do with the not inconsiderable number of patients between the ages of twenty and thirty who are suffering from uterine myomata? To deprive these young women of so important an organ as the uterus in the early years of their life is a serious matter, and I believe that increasing experience will show that it is seldom necessary. Between the ages of thirty and forty each case must be judged upon its merits, and the wishes of the individual patient should be an important factor in deciding the question of the type of operation.

It is estimated that 10 per cent. of white women and 30 per cent. of colored women have myomata of the uterus at the age of fifty, but in the large majority the tumors are small and symptomless, and only a limited number give sufficient symptoms to induce the patient to consult a physician or to require surgical interference.

Noble[6] has demonstrated that in 2,274 operations for uterine myomata and complications, the pathologic condition showed that in about 30 per cent. of the cases death would have followed eventually if the patients had not been operated upon.

Degeneration due to or associated with changes in the nutrition of the tumor, or infection (one or both), is found in 18 per cent. of the operated cases. Fifteen per cent. are of the simpler forms, *i. e.*, edema, red degeneration, cystic degeneration, etc. Three per cent. suffer from necrosis of the tumor, one of the most serious consequences which can befall a woman with myomata of the uterus. The necrosis often results in general septic peritonitis and death unless promptly operated upon. In these non-malignant forms of degeneration myomectomy can be resorted to in suitable cases, but in malignant degeneration myomectomy is not to be considered.

It is estimated that about 30 per cent. of patients with myomata of the uterus have associated diseases of the ovaries and tubes sufficient to necessitate their removal. This is a somewhat higher percentage than is shown by our experience, and it possibly includes some cases of enlargement of the ovaries due to simple hypertrophy, which, as Clark and Norris[7] point out, is often associated with myomata and does not necessitate removal of the hypertrophied organ. Of course, if the ovaries are in a condition to require their removal, myomectomy is contraindicated.

The most serious objection urged against myomectomy is the increased mortality of the operation itself, from hemorrhage, sepsis, and other complications; and yet in 157 unselected and consecutive abdominal myomectomies we have had but one death. Early in our experience some of the patients gave us considerable anxiety following operation. Their convalescence was not always uneventful, but was sometimes attended with a quick pulse, tympanites, and other evidences of serious constitutional as well as local disturbances.

About ten years ago A. J. Ochsner was visiting our clinic, and while making a myomectomy I remarked that it was an operation which I feared. Ochsner[8] said very promptly, "You will not fear it if you don't tie your sutures so tight." Referring to the catgut suture I had used in drawing the cavity in the uterine wall together, from which I had removed the myoma, he said: "If you will put in these sutures just tight enough to *coapt* the tissues and stop hemorrhage, and not tight enough to *bleach* the tissues, you will have no trouble." The uterine tissues in the non-pregnant state are firm and unyielding, and disastrous consequences are experienced from tension, which also acts as an invitation to infection. We have followed Ochsner's advice ever since, and I consider his teachings in regard to the danger of suture tension, not only in myomectomies but in all operations, one of the many valuable contributions he has made to surgery.

As to hemorrhage: the use of the continuous catgut suture closing all of the dead space, as a rule, leaves little to be desired in the way of safety, but the removal of a uterine myoma in the course of pregnancy may be followed by an oozing of blood from the needle punctures, and as a final precaution in such cases we have taken the tip of the omentum and fastened it with fine catgut sutures as a compression pad against the oozing points in the suture-line (Figs. 168, 169, and 170), thus checking the hemorrhage and preventing

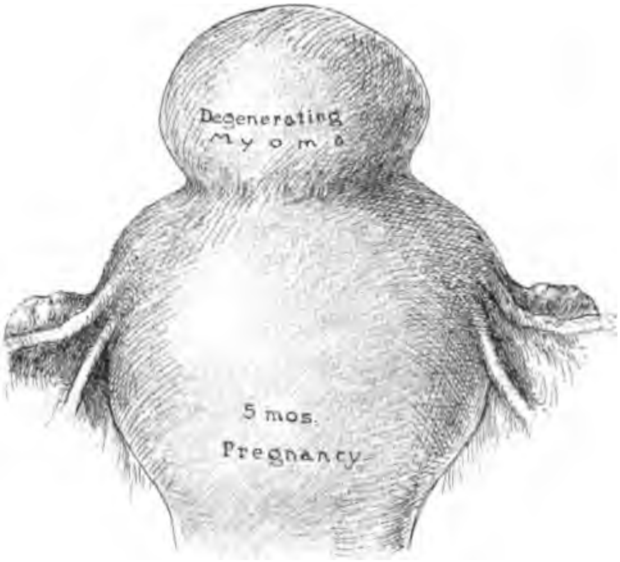

Fig. 168.—Degenerating uterine myoma complicating pregnancy at five months.

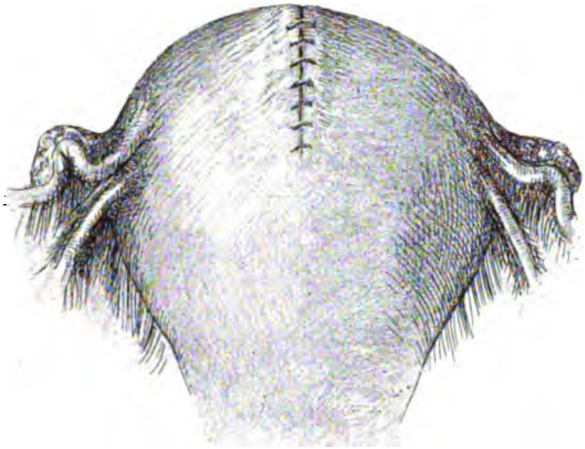

Fig. 169.—Myoma removed and uterine wound sutured with catgut.

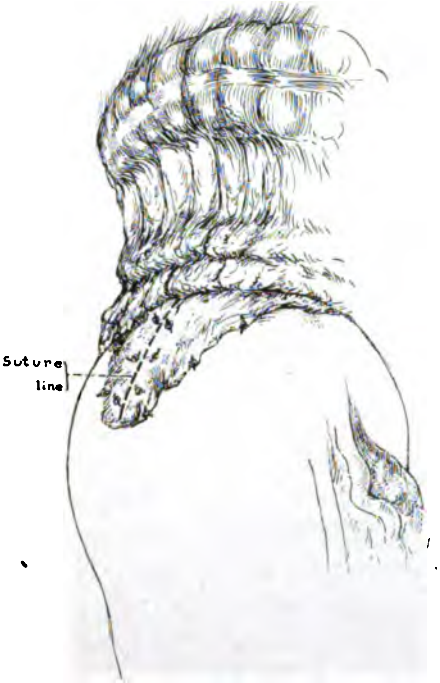

Fig. 170.—Edge of the omentum fastened to the sutured uterine wall as a compression pad to check the oozing of blood from the suture lines and to prevent harmful adhesions.

intestinal adhesions. The freely moving omentum follows the contraction of the uterus in the process of labor without interfering with parturition.

Opening the cavity of the uterus during a myomectomy in the non-pregnant state is not a serious matter unless there is infection present, as pointed out by the late Andrew J. McCosh.[9] If the endometrium is very thick, it can be curetted away most effectively under direct inspection. W. W. Russel[10] shows the advantage of curettment of the uterus under direct suprapubic inspection through an incision in the anterior uterine wall, and we have found this procedure very useful. In this way we have, in several cases, saved a uterus from hysterectomy which was bleeding seriously from a polypus in one horn of the uterus which could not be, or at

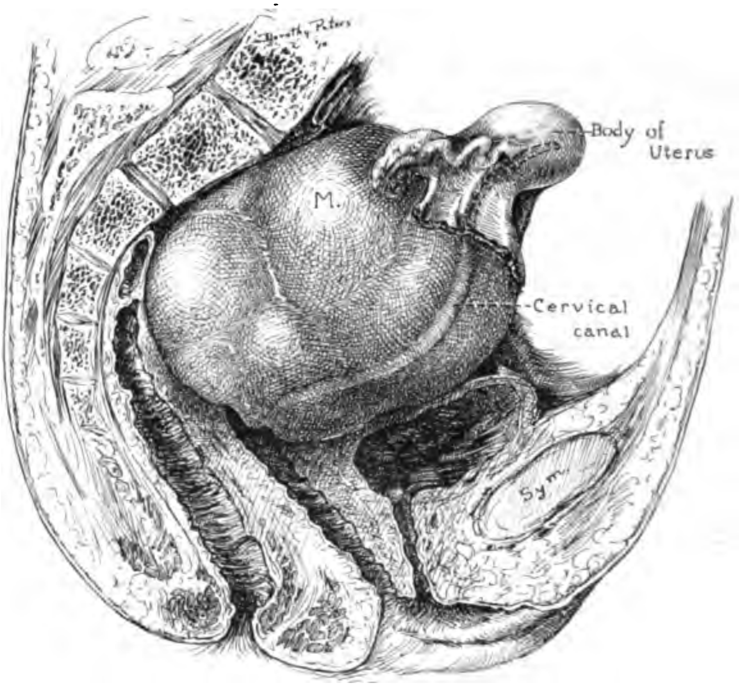

Fig. 171.—Myoma originating in the cervix and filling the pelvis, carrying the body of the uterus upward and enlarging the cervical canal to seven inches in length. M, Myoma.

least had not been, removed by several curettments. Artificial drainage downward through the cervix should, if possible, be avoided if the endometrium is invaded during myomectomy.

On a few occasions, in operating upon young women, we have removed one entire wall of the uterus and one ovary and tube, the remaining ovary and tube being healthy. We have then fashioned the remainder of the uterine wall into something resembling a uterus, bending it upon itself with such necessary trimming, gores, and pleats as may be necessary to form a uterus with an endometrium. These patients have menstruated regularly and painlessly, and some of them have since married, but, so far as we know, they have remained sterile. In one case (a virgin of twenty-two years) we were able to remove a myoma of the cervix uteri larger than a grape-fruit which was impacted in the pelvis and which necessitated the removal of the entire cervical canal from a point just below the internal os to a point slightly above the vagina.

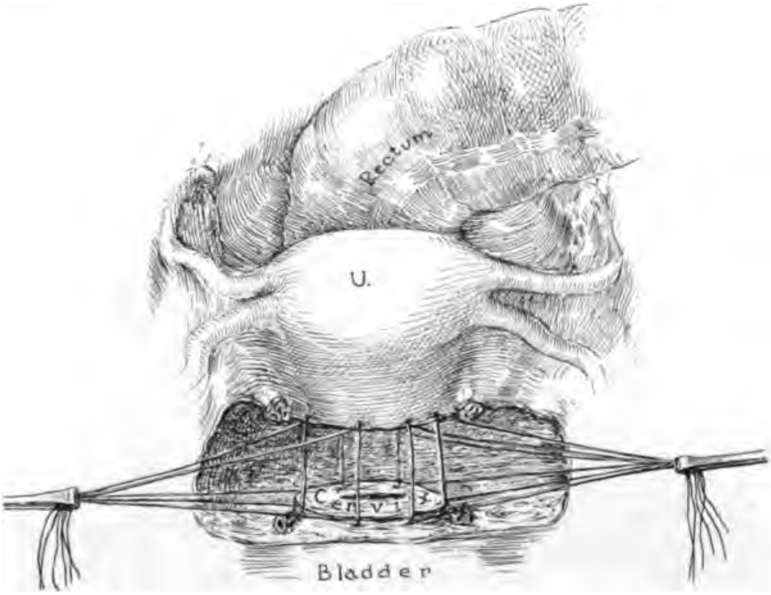

Fig. 172.—Myomectomy with resection of the cervical canal. U, Uterus.

With some difficulty we sutured this widely separated fundus to the vaginal remnant of the cervical canal with catgut sutures, and secured a perfect result (Figs. 171, 172, and 173). The patient menstruates regularly and without pain.

A possible objection to myomectomy lies in the danger of overlooking some small myomata which later will necessitate a second operation. This occurred twice in our series, once eight years and once six and a half years following the first operation. This is a risk which cannot be eliminated, and must be accepted as such by the patient.

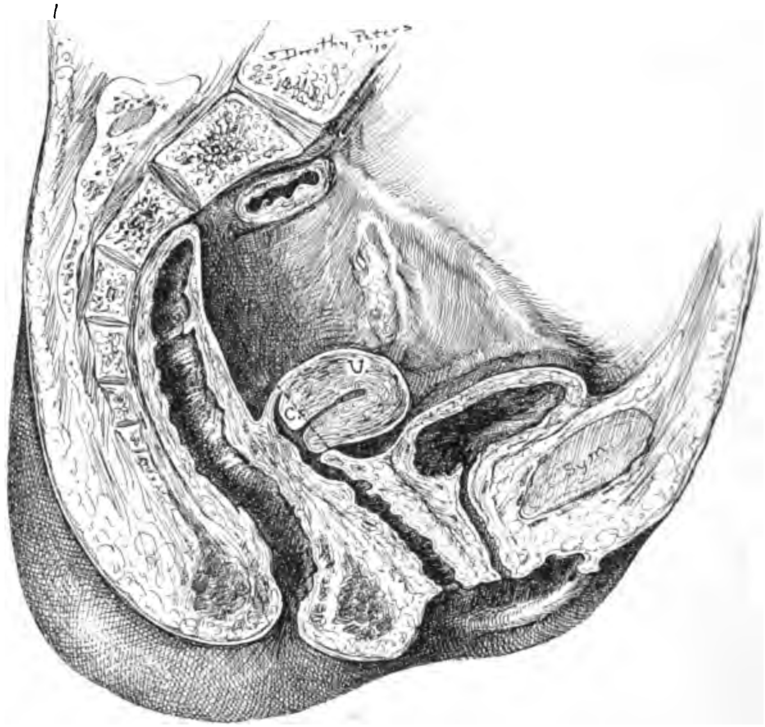

Fig. 173.—End-to-end anastomosis of the body of the uterus to the stump of the cervix. C, Cervix; U. uterus.

Myomectomy during the course of pregnancy is often indicated, and in our experience, covering a number of cases, we have had no deaths and only one miscarriage, imminent in this case at the time of operation, which was undertaken with the hope that removal of the degenerating tumor would check the miscarriage. This had been our fortunate experience in several previous cases.

It has been observed generally by the profession that the majority of women with myomata of the uterus undergo pregnancy and often repeated pregnancies with but little difficulty, and it is astonishing to see how tumors impacted in the pelvis are sometimes lifted out spontaneously in the course of pregnancy. The necessity, therefore, of emptying the uterus when myomata complicate pregnancy very rarely occurs, and hysteromyomectomy with the non-viable child must be one of the rarest necessities in surgery, because myomectomy is usually adequate to relieve the patient if acute degenerative changes occur during the course of pregnancy, and elective puerperal hysteromyomectomy (Porro operation) at term in cases where myomata are obstructing the pelvic outlet will, in the majority of instances, save both mother and child.

In a considerable experience in elective cesarean section with hysteromyomectomy we have not lost a mother or a child, if the child was living at the time of operation. Craniotomy and embryotomy not only destroy the child, but often the mother is lost because of hemorrhage and sepsis. These operations have no place in the treatment of myomata complicating pregnancy, unless under exceptional circumstances.

In going over the cases of uterine myomata which were operated upon in our clinic (C. H. and W. J. Mayo) at St. Mary's Hospital, from January 1, 1901, to the present date—December 31, 1910—some interesting mortality data are furnished, which will be briefly summarized herewith.

These statistics include all varieties of operations and the various complications, such as cancer, tubal infections, necrosis and degenerations of the tumor, etc. Every patient dying in the Hospital, irrespective of the cause of death or the length of time following operation, is counted as dying from the operation.

Total number of operations for uterine myomata	1244
Deaths (2.3 per cent.)	30
Total number of appendectomies	686
“ “ “ gall-stone operations	92
“ “ “ hernias	35
“ “ “ resections, pyloric end of stomach	1
“ “ “ resections of sigmoid	4
“ “ “ Meckel's diverticulum	2
“ “ “ coincident operations	820
Number of cases of myomata of the uterus which necessitated total abdominal hysterectomy, usually because of malignant degeneration or acute infection	66
Deaths (3 per cent.)	2
Number of supravaginal hysterectomies	900
Deaths (2½ per cent.)	23
Number of abdominal myomectomies	157
Deaths (⅔ of 1 per cent.)	1
Number of vaginal hysterectomies	77
Deaths (2¾ per cent.)	2
Number of vaginal myomectomies	50
Deaths (4 per cent.)	2

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DEFORMITIES OF THE RENAL PELVIS*

By WILLIAM F. BRAASCH

During the past year my attention had been called repeatedly to the fact that moderate dilatation of the renal pelvis occurred in conditions other than hydronephrosis; furthermore, that the ureteral catheter could meet with obstruction in the pelvis without a stone being present. Both these data were acquired with the aid of the ureteral catheter in various pathologic renal conditions, more often with hypernephromata. Most of the hypernephromata removed in the clinic at St. Mary's Hospital showed on section marked deformity of the renal pelvis; either irregular dilatation of the pelvis, entire or in part, or encroachment upon the pelvic lumen by projections of the surrounding tumor substance. It occurred to me that a radiographic demonstration of these deformities could be of considerable aid in the diagnosis of hypernephromata, frequently so difficult to establish clinically.

Upon investigation it was found that Voelcker, of Heidelberg, had made a radiographic demonstration of the outline of the renal pelvis several years ago, using collargol as the injected medium. He had demonstrated several cases of hydronephrosis in this manner and suggested further possibilities of this method as an aid to renal diagnosis.

Using a 10 per cent. solution of collargol as the injected medium in subsequent radiographs, we were able to outline the pelvis quite definitely. The radiographs (Figs. 174 to 191) will illustrate some of the pelvic deformities and associated data which we have demonstrated by this method.

1. *The Normal Pelvis.*—Variations will be considerable in the

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* Read by invitation before the Society of Clinical Surgery, Rochester, Minnesota, Oct. 30, 1909. (Reprinted from "Annals of Surgery," April, 1910.)

normal outline. The number, depth, breadth, and contour of the calyces will vary greatly. The extent to which the free wall of the pelvis will distend beyond the kidney border will differ; nevertheless there are limits to which the normal outline is confined. (See Figs. 174 to 178.)

2. *Hydronephrosis.*—Heretofore in demonstrating surgical dilatations of the renal pelvis we have employed the method introduced by Kelly, *i. e.*, determining the amount of fluid injected into the pelvis necessary to produce renal colic. If correctly employed, this method should rarely permit of error. However, in small dilatations and with impassable ureteral obstructions there may be doubt in some cases. Again, unless familiar with the technic one might interpret the findings falsely. Furthermore, to have a condition unmistakably outlined "in black and white," as shown in Figs. 179 to 183, is a source of satisfaction.

3. *Etiologic Factors.*—In several of the plates etiologic factors in the dilatation were quite clearly shown. Referring back to Fig. 179, it will be seen that opposite the shadow of the renal pelvis is a marked scoliosis involving the second lumbar vertebra. That scoliosis may indirectly be an etiologic factor in hydronephrosis has been previously suggested.* At operation, a band of tissue, the evident result of some paravertebral inflammatory process, was found to be constricting the ureter and causing pelvic dilatation. Anomalous renal blood-vessels usually constrict the ureter near the level of the lower pole of the kidney, into which they pass. As a result one would expect an elongated or pear-shaped dilatation. This is clearly demonstrated in Fig. 180, where such a vessel was the direct cause. (See Figs. 184 and 185.)

4. *Hypernephromata.*—Of the thirty hypernephromata removed in the clinic at St. Mary's Hospital, nearly all show more or less deformity of the renal pelvis. We have been able to demonstrate this deformity clinically in three collargol plates. The surrounding neoplasm may cause either necrosis or diminution in the size of the pelvis. The dilatation is due, in the first place, to retraction of the walls of the pelvis by the surrounding tumor. This is

* Israel: "Chirurgische Klinik der nieren Krankheiten."

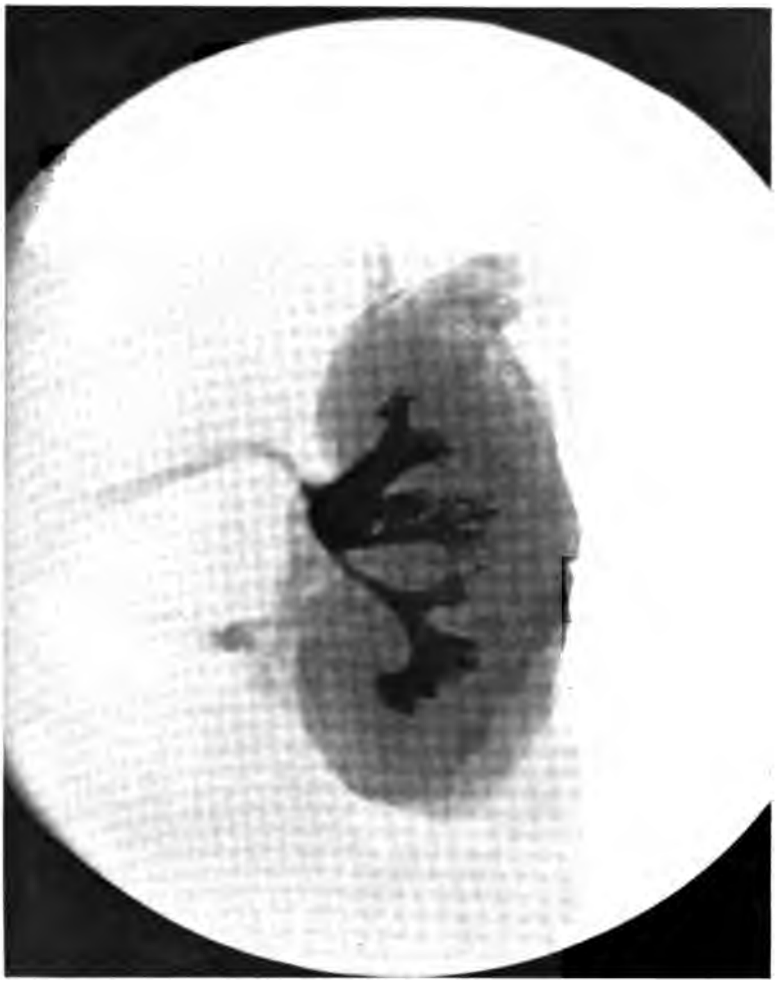

Fig. 174.—The radiograph shows the outline of a renal pelvis in a postmortem specimen. It is necessarily more clearly defined than if the kidney had been in the living subject. That the free wall does not give way more is probably to be explained by postmortem tissue changes. Why the renal pelvis at postmortem usually shows a cubic content of from 2 to 5 c.c., whereas in the living it is often found to hold as much as 20 c.c., or more, may be explained by these postmortem changes.

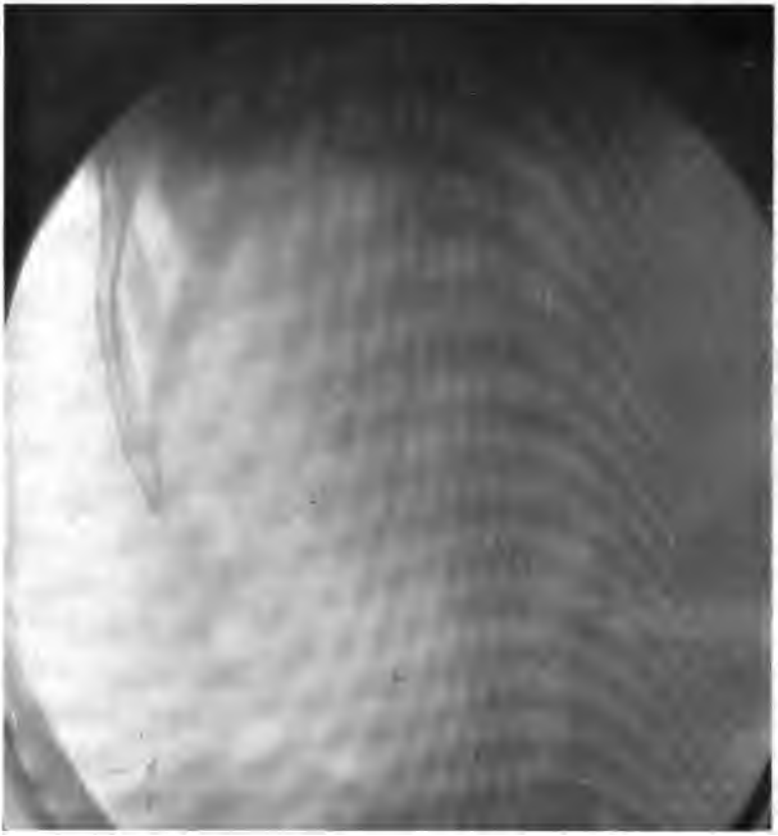

Fig. 175.—This is the outline of a normal renal pelvis. The several calyces and rounded papillæ between are clearly outlined. The free wall is seen bulging moderately and tapering into the upper part of the ureter, which is shown as far down as the collum uretericum. At this point of narrowing the collargol is usually prevented from running back alongside the catheter.

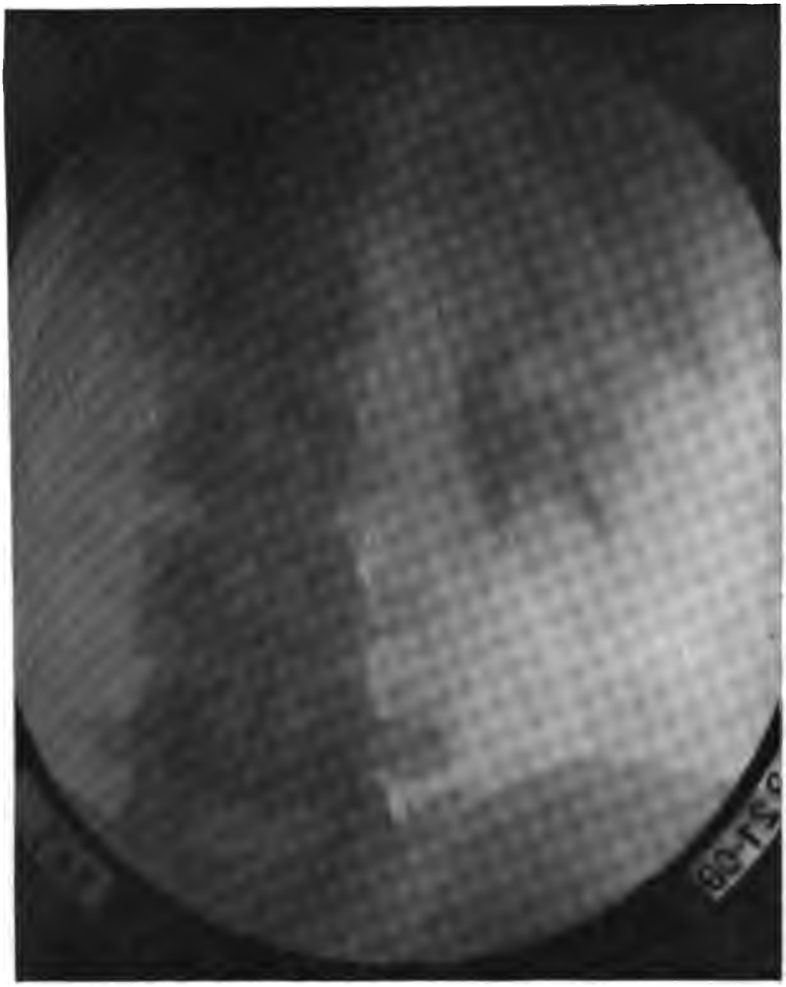

Fig. 176.—This plate shows the normal outline of a pelvis in a floating kidney. The pelvis contained 18 c.c. of injected fluid before artificial renal colic was produced. The patient was aware that the kidney was movable, and complained of more or less pain in that side. The ureter is clearly outlined by the collargol within the ureteral catheter and shows no evidence of a kink. There is no return flow alongside the catheter, otherwise it would be shown in the plate.

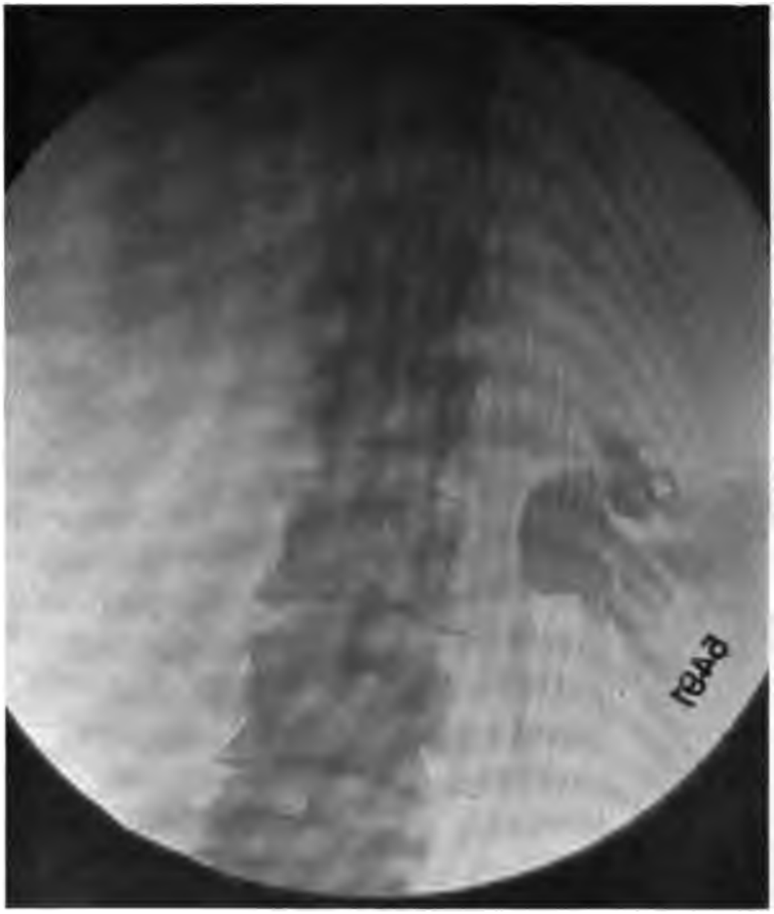

Fig. 177.—Here again is shown the outline of a normal pelvis which might be mistaken for that of a small hydronephrosis. Its actual size may be slightly exaggerated by the kidney moving with the respiration of the patient. The seeming detached shadows of the calyces is a peculiarity sometimes found. The plate shows in a striking manner the return flow along the side of the catheter.

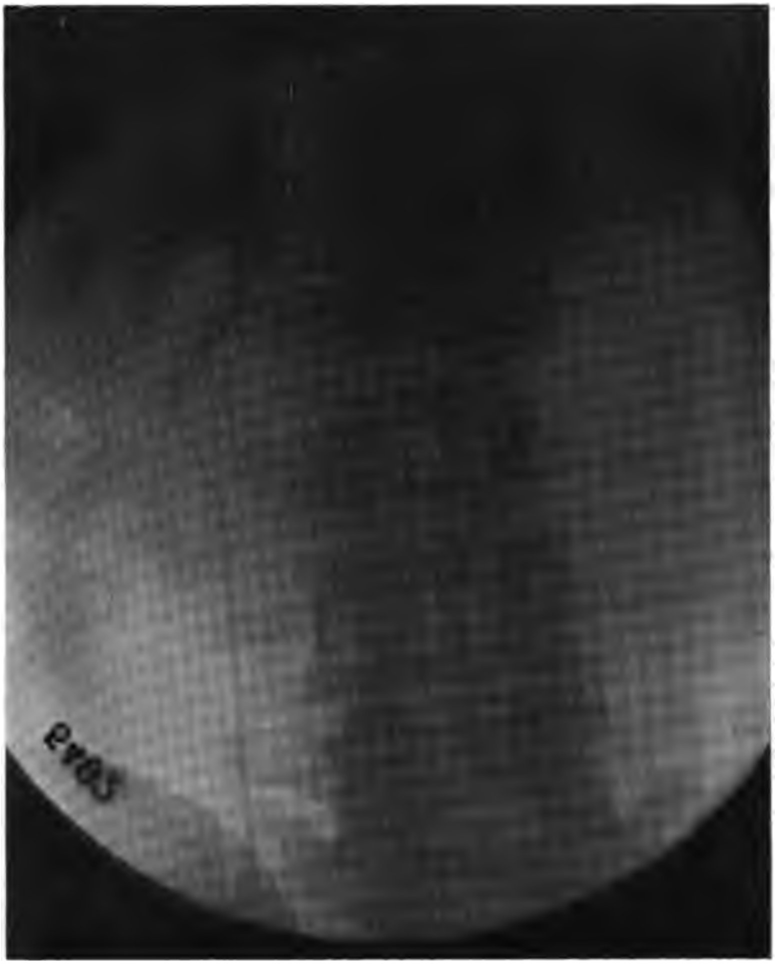

Fig. 178.—This also shows the outline of a normal pelvis which contained 20 c.c. It is of interest, in that it shows the extent to which the free wall can bulge without a hydronephrosis being present.

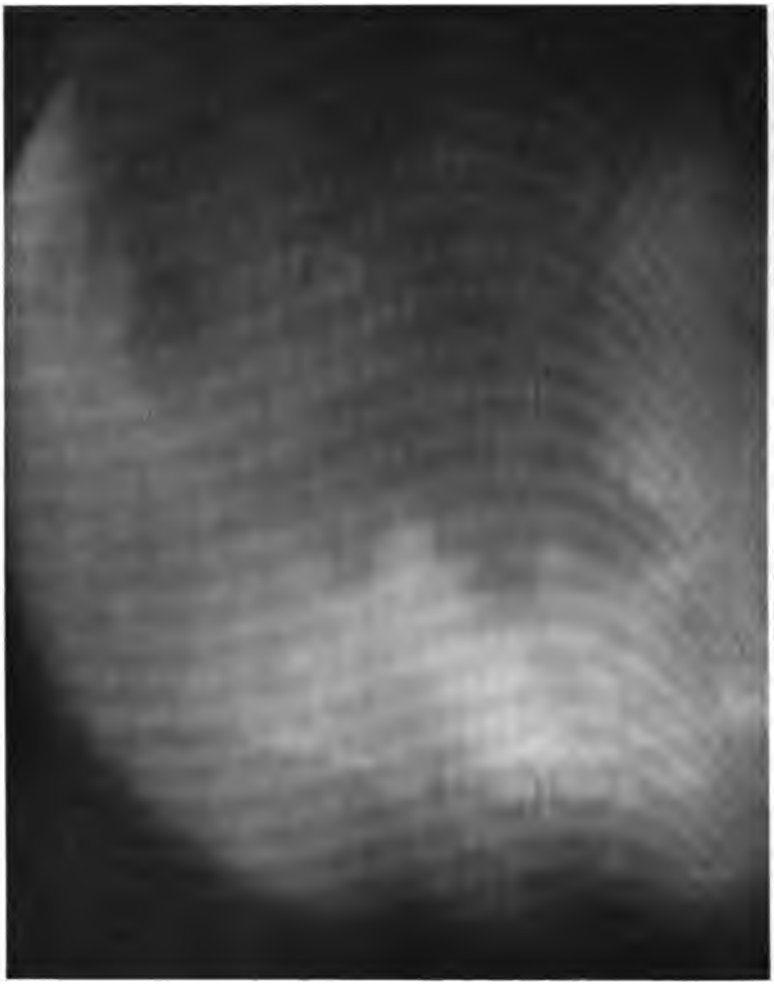

Fig. 179.—Here the pelvic outline is very evidently larger and more irregular than that of the normal pelvis previously shown. This is the pelvis of a small hydronephrosis holding about 50 c.c.

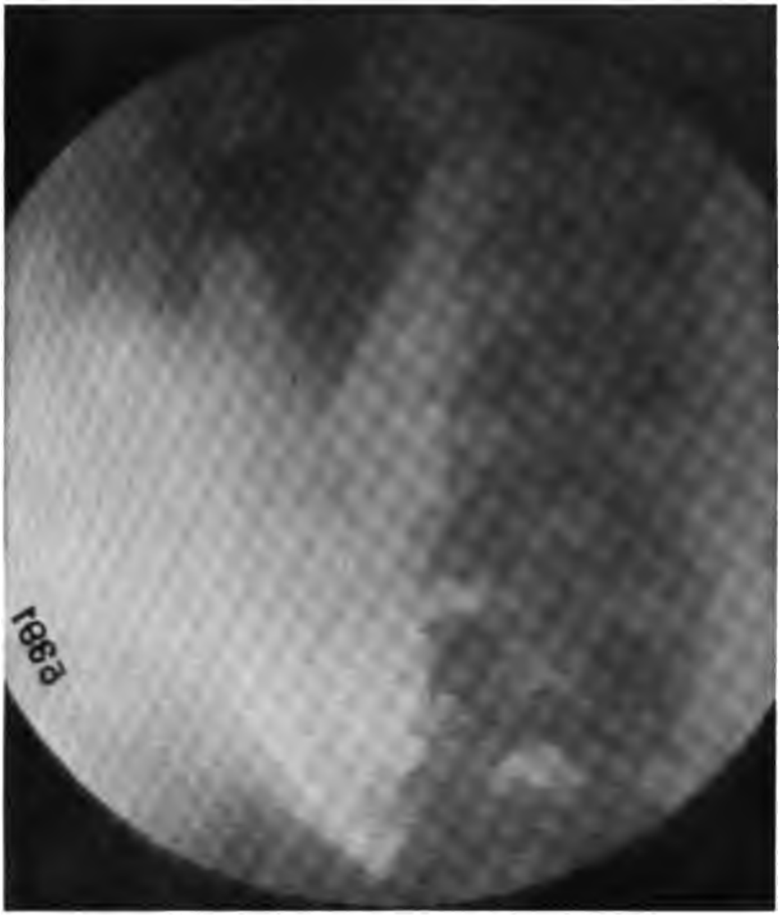

Fig. 180.—This plate shows a larger though still moderate dilatation containing about 100 c.c. The sac is pyramidal and is made of the dilated pelvis at the base tapering into the dilated first part of the ureter. This is due to the fact that the ureteral constriction is at some distance below the pelvis, in this case an anomalous blood-vessel.

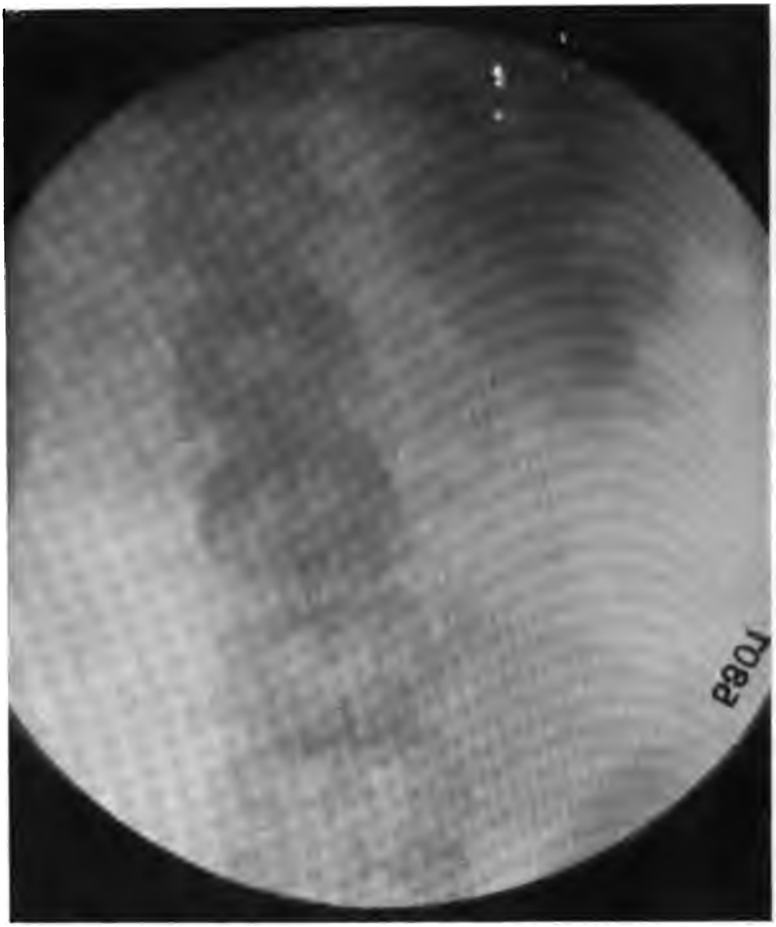

Fig. 181.—Here a rather large dilatation containing 150 c.c. is demonstrated. The sac is seen bulging out beyond the outline of the kidney. The calyces are seen shallow and broad, as is usual in hydronephrosis, unless inflammatory changes intervene.

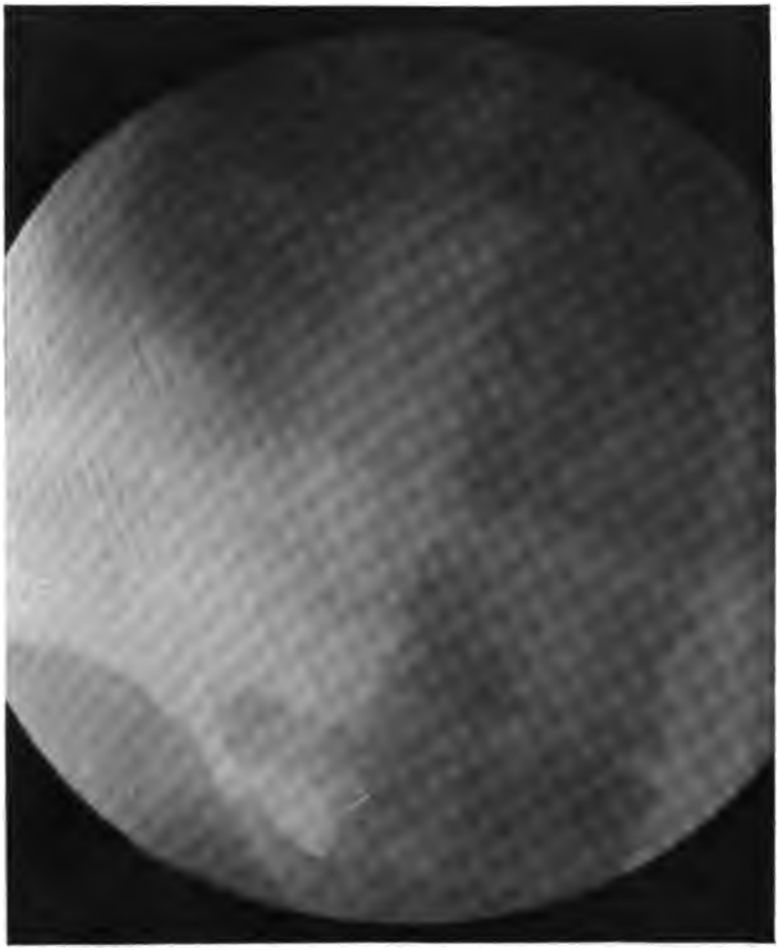

Fig. 182.—A still larger dilatation is seen, occupying the left upper abdominal quadrant. All vestiges of the calyces and pyramids are destroyed.

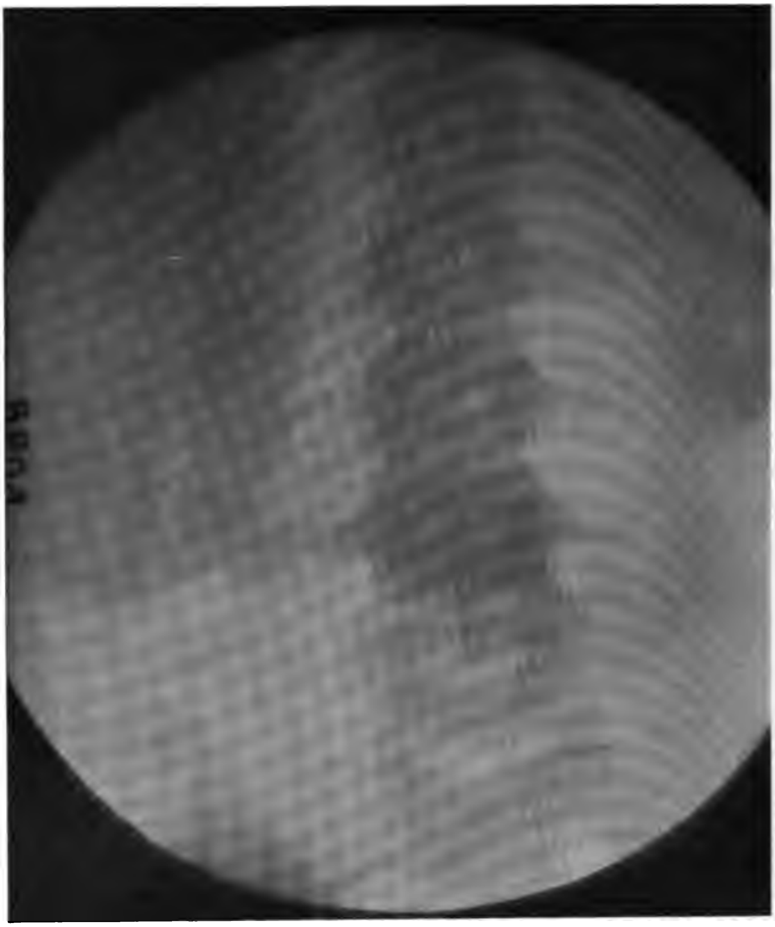

Fig. 183.—This is an extreme dilatation filling the left abdomen. On operation an immense fluid-filled sac with but a rim of functionless cortex was found.

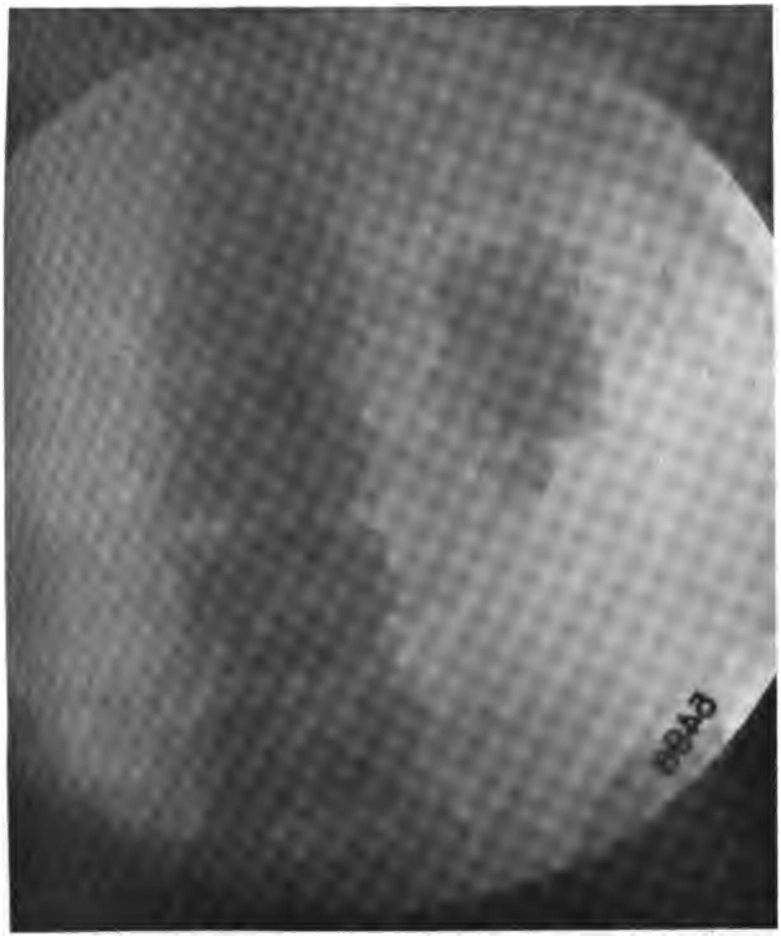

Fig. 184.—The outline of this dilatation will be found to differ considerably from the general type of those preceding. It is seen to be less rounded and is very irregular with several small detached shadows. This pelvis is a tuberculous hydronephrosis and is typical of an inflammatory dilatation.

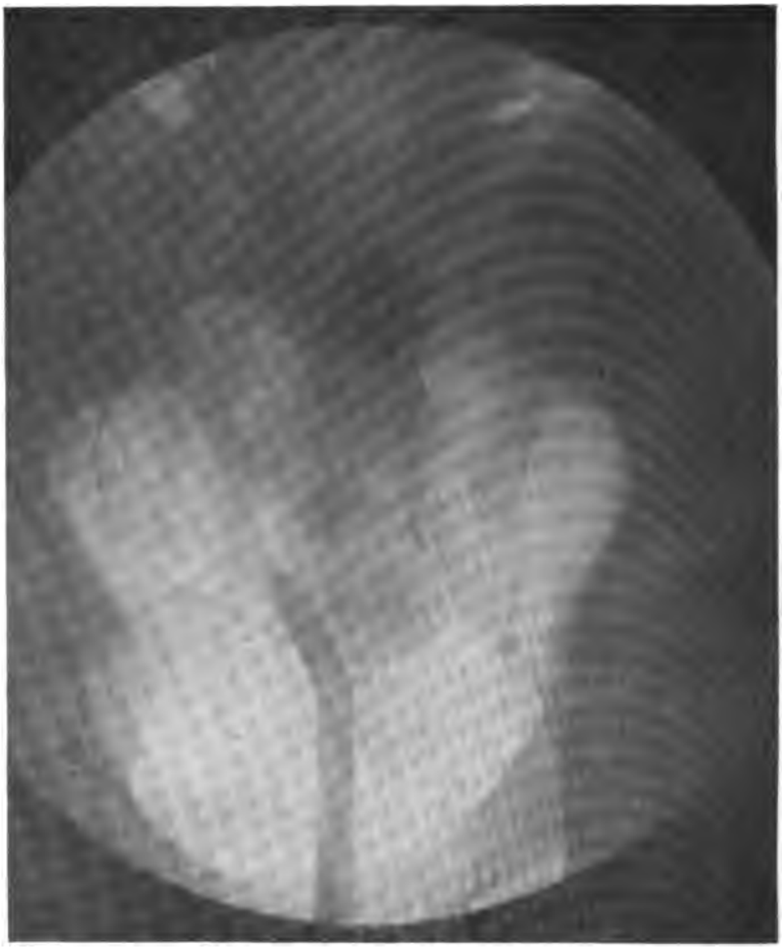

Fig. 185.—While not exactly relevant to the subject, the plate illustrates a ready source of error in radiographic diagnosis. It is to be inferred here that the wire stilet is in direct line with an ureteral stone. A hydronephrosis on the same side, having been previously demonstrated by fluid measurement, renders the inference still more favorable. However, on referring back to Fig. 182 no evidence of a dilated ureter is to be seen. The rounded hydronephrotic sac is seen extending abruptly from the normal calibered ureter. This would be inconsistent were the stone the cause. At operation no evidence of a ureteral stone was found.

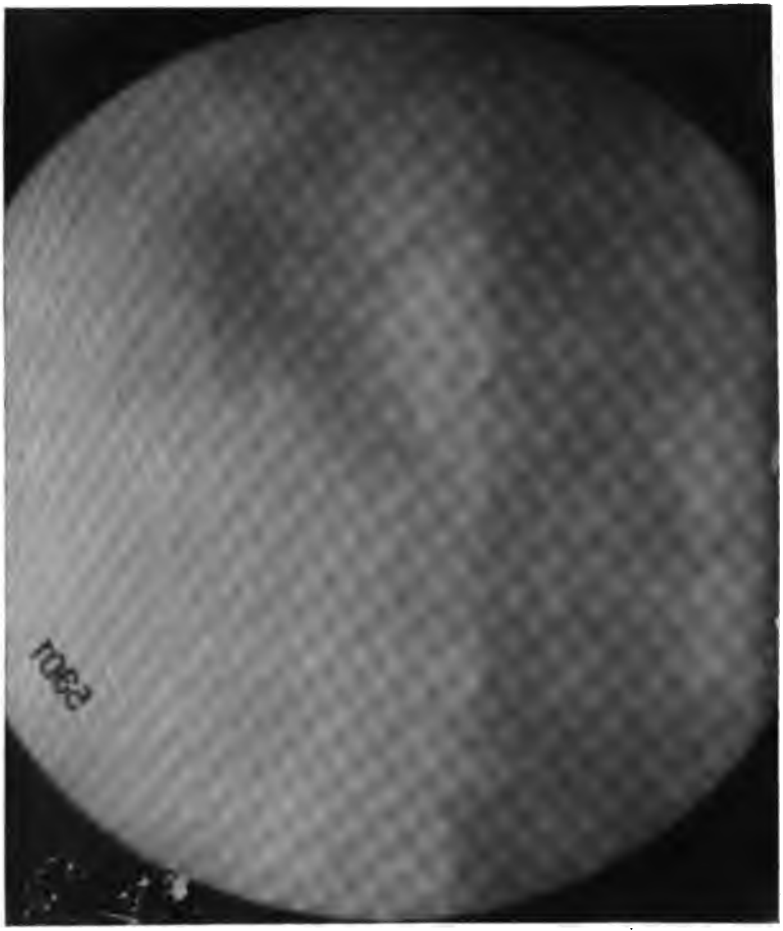

Fig. 186

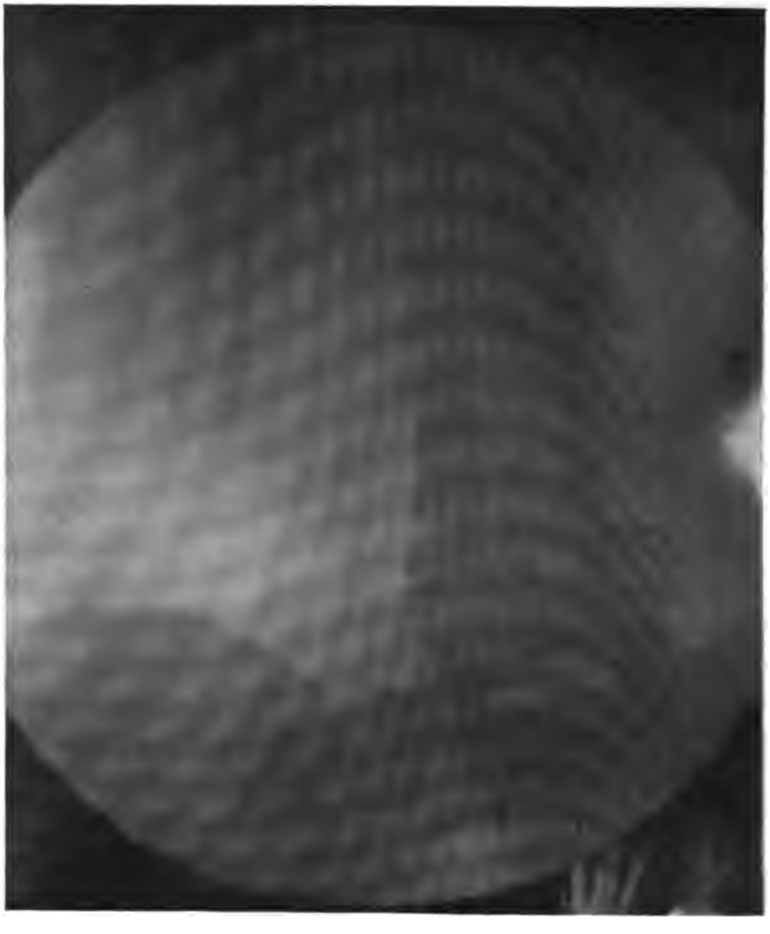

Fig. 187.

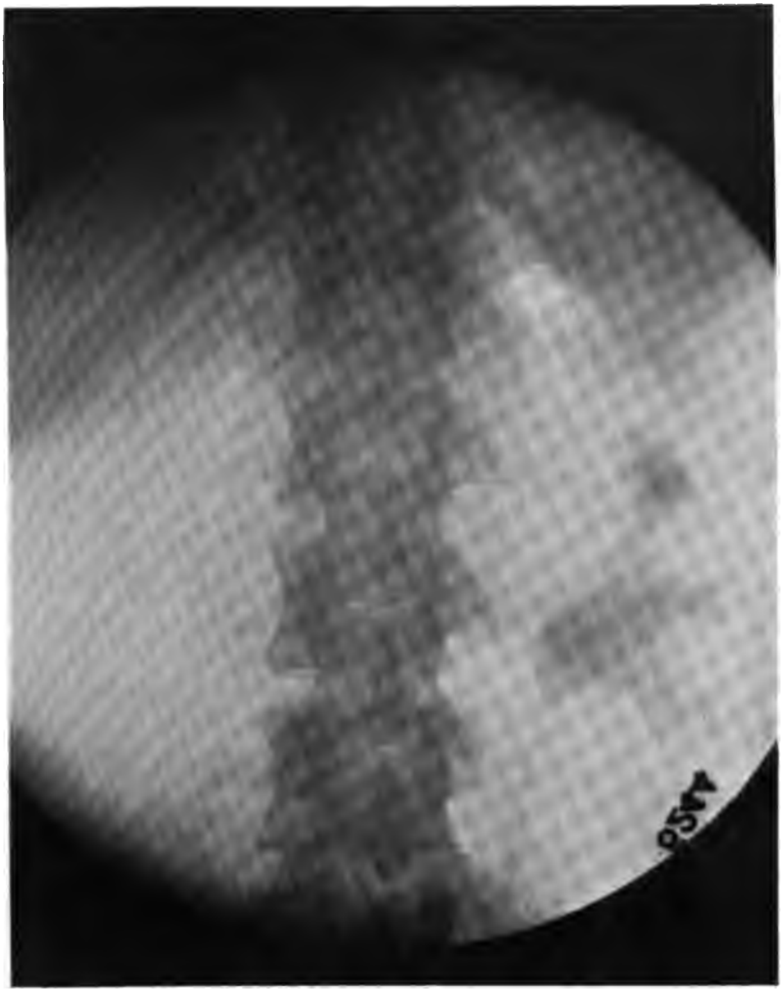

Fig. 188.—This figure shows the pelvis of a solitary kidney. The patient presented herself with symptoms of gall-stones. On examination a tumor was palpated in the right upper abdomen which was regarded as an enlarged kidney. Cystoscopic examination showed urine from the right side only. Thirty c.c. of collargol solution were injected into the pelvis before causing any pain. The collargol plate shows a pelvis about the normal size. Although abnormally large, the pelvis shows a normal contour; the papillæ are not flattened nor are the calyces wider, as in a hydronephrosis. The plate makes the diagnosis of a single hypertrophied kidney quite evident. The patient was operated upon for gall-stones and on exploration the kidney diagnosis was confirmed.

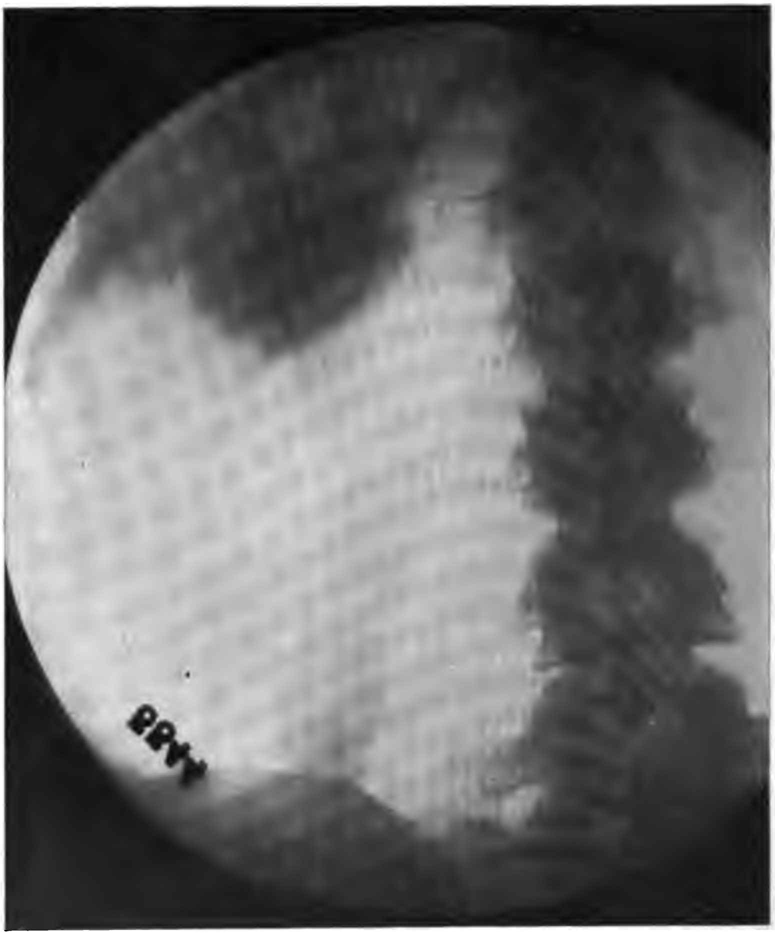

Fig. 189.—This gives the dense shadow of a large stone, showing the paler collargol shadow. It is thus necessarily located in the pelvis. The pelvis is seen to be greatly dilated and irregular. This cut also demonstrates the possibility of ascertaining the condition of the ureter. Ureteral catheterization in this case showed obstruction in the ureter just beyond the meatus. This was passed with difficulty and a dilatation above was suspected from the ease with which the catheter slipped up beyond. Injected collargol shows the widely dilated ureter as seen in the plate. The dilatation is seen to extend up as far as the collum uretericum, thence the ureter narrows tortuously to the dilated pelvis. Unfortunately the plate does not show the dilated portion of the ureter, which on operation was found extending down to the bladder. Quite frequently that portion of the ureter above a ureteral stone will be found at operation to be dilated. This can often be demonstrated in a collargol plate, and may be valuable evidence in proving the existence of an obstruction which the unaided radiograph does not show.

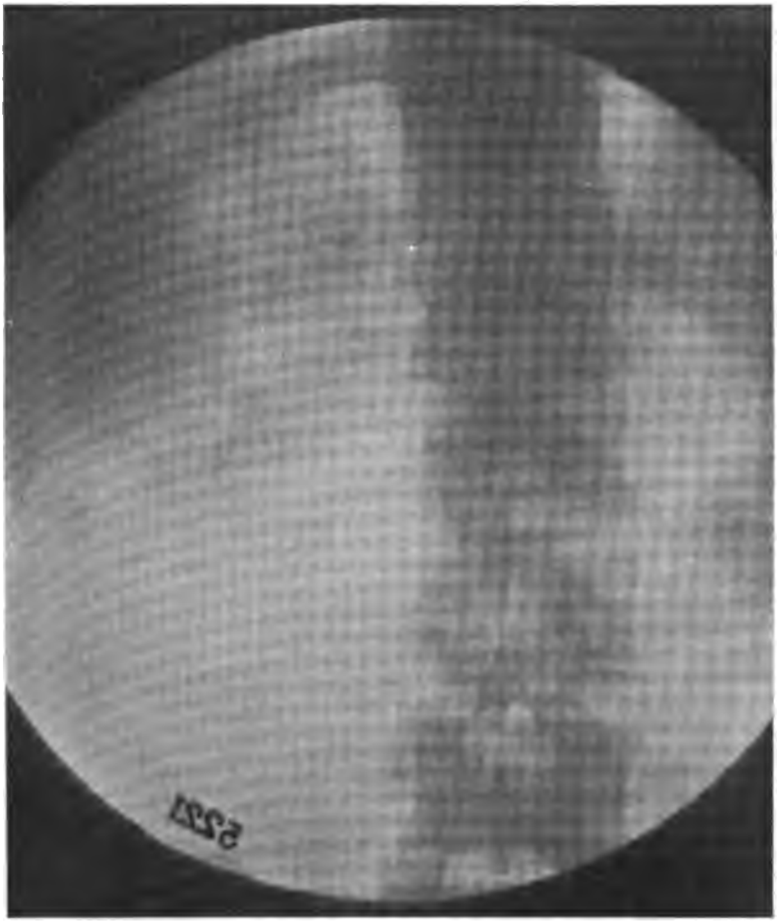

Fig. 190.—This is the radiograph of a pelvis in a case of essential clinical hematuria. The hemorrhagic urine was seen on cystoscopic examination exuding from the affected meatus. The pelvis is irregular and quite different in outline from the normal pelvis. One calyx is seen to extend upward abnormally as a long thin crevice. Unfortunately the man was not operated upon.

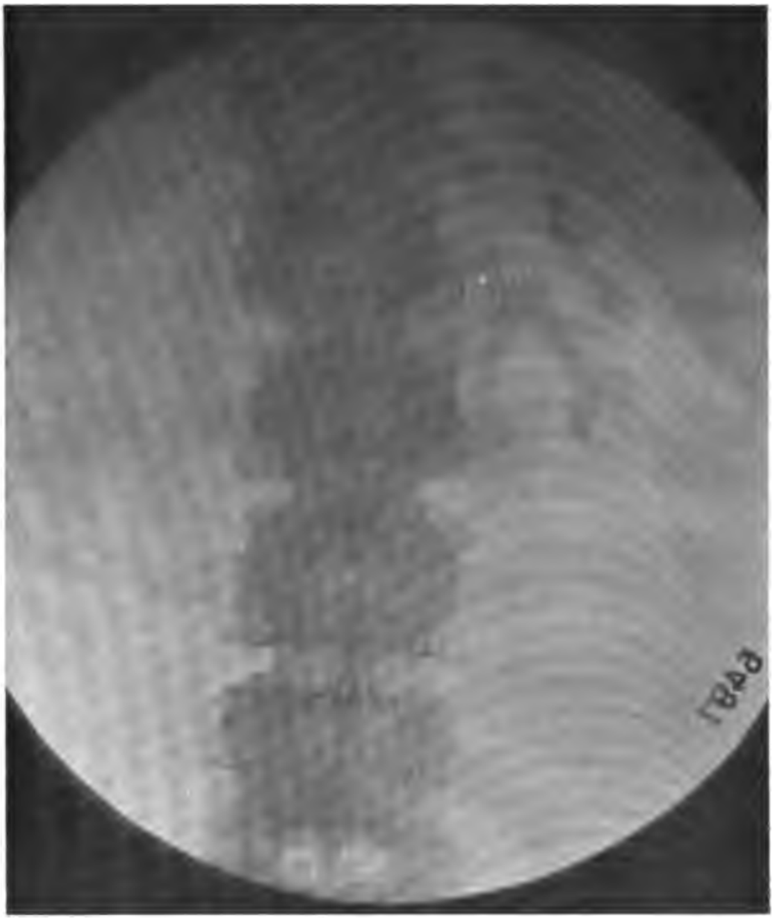

Fig 191.—This shows the pelvis taken in another case of essential hematuria. The pelvis appears quite normal in outline. Nothing in the patient's history seemed to warrant an exploratory operation.

clearly demonstrated in Fig. 186. The pelvis will be seen to be cylindrical and abnormally broad at the ureteropelvic juncture. The infundibula will be seen. short and broad. The removed kidney showed changes in the pelvic outline exactly corresponding to those seen in the collargol plate. The pelvic dilatation may be confined to a single calyx, drawing it out into abnormal lengths, as shown in Fig. 187. Again, the dilatation may be due to secondary degeneration of the surrounding tumor, with consequent sacculation of the pelvic walls, as seen in several of our specimens. If, however, the neoplasm encroaches upon the pelvic lumen, marked diminution in size and content may result. Frequently but a small space is left of the former pelvis. In one of our plates it is shown as a small and irregular area at the end of the ureter. The plate is so dim, however, that the shadow could not, unfortunately, be clearly reproduced in a print. In several of our specimens a tongue of the tumor extends into the pelvic lumen, reaching even to the ureteropelvic juncture. In such cases a wedge-like shadow should be cast between the lateral collargol streaks. How often the pelvic deformity accompanying hypernephromata can be definitely shown in collargol plates remains to be seen. It is, however, significant that in the three hypernephromata so far radiographed by us the abnormality was demonstrated in all.

5. *Solitary Kidney.* (See Fig. 188.)

6. *Localization of Renal Stone.*—Frequently a shadow is seen in the region of the kidney and its exact relation to the pelvis is in doubt. If the stone is within the pelvis, its shadow will be either obliterated in a collargol plate, or it will appear dimmed by the surrounding collargol shadow. If the shadow is shown to be distinct from the pelvis, in a collargol plate, the stone must be without the pelvis. Its relative position in the cortex may then be inferred, particularly if the shadow of the kidney can be brought out in the plate. (See Fig. 189.)

7. *Hydro-ureter.* (See Fig. 189.)

8. *Essential Hematuria.*—Renal hemorrhage is a very perplexing condition to deal with. The radiograph being negative, we must still consider the possible presence of a surgical condition.

Pelvic deformities other than those accompanying hypernephromata may exist when caused by pelvic papillomata and angiomata, varicose contracted conditions of the pelvic wall, and occasionally cystic kidneys. These deformities may frequently be suggested by collargol radiographs. (See Figs. 190 and 191.)

9. *Tumor Differentiation.*—It is common experience to meet with abdominal tumors whose clinical identification is difficult. Large pancreatic and ovarian cysts, intestinal, gall-bladder, and stomach tumors, and various perirenal growths with indefinite histories, may be easily confused with renal conditions. In such cases if a collargol radiograph is made, and the renal pelvis is found to be in the *normal position* and with a *normal outline*, the tumor is probably not renal. On the other hand, renal tumors may be so low as to simulate tumors of the neighboring organs. It will be remembered that in Fig. 184 a pyonephrosis was demonstrated. The patient in this case presented an abdominal tumor so low as to lead us to suspect it to be in the cecum. The clinical history also supported this supposition, even though cystoscopic examination showed pus from that side. The collargol plate, however, shows the pelvis to be unusually low and corresponding to the tumor felt.

In presenting these plates I realize that the possibilities of the method have not been fully developed. Furthermore, that it remains to be seen how often the method will prove to be of practical diagnostic value. That it is of value in some conditions is evident from the accompanying radiographs. It is also self-evident that much of the success of the method will depend upon the excellence of the radiograph. The accompanying prints scarcely do justice to the radiographs from which they were made. The original plates were made by V. J. Willey.

RECENT DEVELOPMENTS IN PYELOGRAPHY*

BY WILLIAM F. BRAASCH

Pyelography is not a new subject. The idea of injecting a substance which is impenetrable to the Röntgen ray into different parts of the urinary tract has for a long time been suggested by various observers.

To Voelcker, of Heidelberg, must be given the credit of first demonstrating a radiogram of an injected renal pelvis in the living, and of calling attention to some of the possibilities of the method. For some reason the method did not arouse any general interest, and nothing more was heard from it until within the last year or two.

So far as I have observed, the plates which had been published at the time I commenced my investigations almost two years ago showed no other condition than that of the normal pelvis and hydronephrosis. In a paper read before the Society of Clinical Surgery, October, 1909, and published in the "Annals of Surgery," April, 1910, I was able to demonstrate plates showing a variety of conditions in the urinary tract, bringing out various associated data. Recognizing the practical value of the method, we have since employed it almost daily in St. Mary's Hospital. The illustrations for this article will be selected from several hundred collargol radiographs which we have made thus far.

Technic.—Following Voelcker's suggestion, we have used collargol as the injected medium in most of our figures. The silver salt casts a definite shadow, and furthermore has the advantage that it can be used in weak solutions. A solution as low as 2 per cent. will often outline the renal pelvis quite clearly, and it can be injected without fear of harmful results. That it is a non-irritant is shown by its well-known use in intravenous injections. At operations we have repeatedly found collargol retained in the renal pelvis, into which it had been injected several weeks before. It seldom causes more than a slight temporary irritation when injected It does not interfere with primary union in operation wounds. Ordinarily we use a 10 or 15 per cent. solution, although a 5 per cent. solution suffices to cast a fair shadow. The stronger solutions generally cast a denser shadow, and retaining fluids in a dilated pelvis will often dilute even a 15 per cent. solution considerably. The amount injected will, of course, depend upon the size of the pelvis; a large hydronephrosis will contain several ounces without harm.

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* Read before the American Urological Society, June, 1910. (Reprinted from "Annals of Surgery," Nov., 1910.)

The Normal Pelvis.—As I have already stated, the normal pelvis will vary much in size and contour. In fact, in order to correctly interpret abnormality of the pelvic outline, one must become familiar with the wide range of pelvic contour. Marked colic, brought on by overdistention, will cause contracture of the normal pelvis and only a small slit will remain. As a rule, a severe colic can be obviated by carefully injecting the fluid while the radiograph is being made. Without going more fully into the subject, I will show two extremes in the pelvic contour. Both were made in females with indefinite tumors in the right hypochondrium which, at operation, proved to be due to distended gall-bladder, while the kidneys were found normal.

Fig. 192 shows the slit-like pelvis in a normal kidney obtained immediately after injecting 3 c.c. of collargol, which caused a severe colic and which might easily be interpreted as the remnant of a pelvis encroached upon by surrounding tumor tissue.

Fig. 193 shows a large pelvis in a normal kidney with a content of 18 c.c. The pelvis, while of fair size, was not found abnormally large nor pathologic in any way. This is one of several figures which we have, showing a large normal pelvis containing from 15 to 25 c.c. collargol.

The Dilated Pelvis.—As before stated, the overdistention method, if correctly employed, is most accurate in determining the existence and extent of a dilated pelvis, provided that the catheter is able to pass the etiologic ureteral obstruction. However, it is always more satisfactory and of great confirmatory value, at least, visibly to demonstrate the dilatation. Furthermore, when the catheter meets an impassable obstruction, enough collargol can frequently be injected past the constriction to outline the pelvis enlargement quite definitely. Fig. 194 illustrates a moderate pelvis outlined under such conditions. With the overdistention method the condition could not be demonstrated because of the immediate return flow of most of the injected fluid. On the other hand, there are undoubtedly hydronephroses which will not appear as such in the injected radiograph. This is particularly true when the dilatation is largely confined within the contour of the kidney, where for some reason the free pelvic wall did not yield. This is graphically illustrated in Fig. 195.

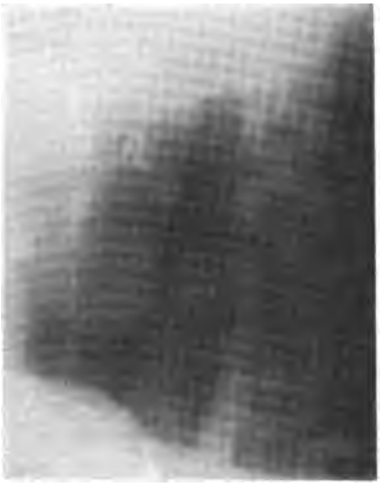

Fig. 192.—Normal pelvis in actual colic after injecting 3 c.c.

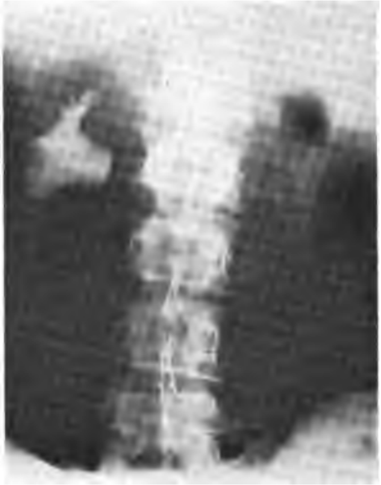

Fig. 193.—Normal pelvis with capacity of 18 c.c.

The etiologic factors, mechanical or inflammatory, are usually quite clearly defined in the pelvic outline. The mechanical or

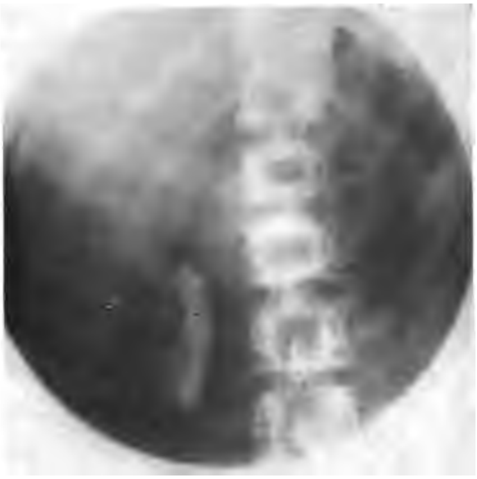

Fig. 194.—A moderate hydronephrosis partially distended because of impassable ureteral obstruction.

retention dilatation is marked by regularity—the even lines of the pelvic wall and the rounded ends of the dilated calyces (Fig. 196). The inflammatory pelvis, on the other hand, is irregular in outline (Fig. 197) and often with detached shadows caused by cortical abscesses connected with the pelvis. Occasionally we will get a combination of both factors. In Fig. 198 we have illustrated a retention pelvis as the result of some peripelvic inflammatory process. The regular dilatation of the calyces is varied by the rather irregular outline of the free pelvic wall.

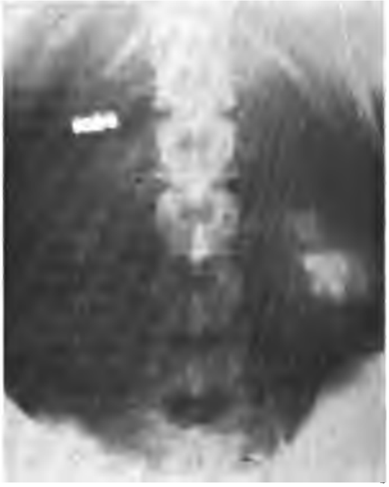

Fig. 195.—A moderate hydronephrosis largely within the renal substance.

Tumor Deformity.—On account of the wide variation of size and shape of the normal renopelvic outline, we must be careful in interpreting a pelvic outline as pathologic. As previously stated, deformity of the renal pelvis caused by tumor will result from retraction of its whole or part of the tumor tissue, or from encroachment of the tumor in the pelvic space. Wilson* has demonstrated that in most renal neoplasms a marked deformity of the renal pelvis is visible in a cross-section. In a previous paper I published two collargol plates showing this deformity prior to operation. Naturally the pelvic outline must vary widely from the normal in order to be recognized as a deformity. In case of tumor retraction the pelvis may be irregularly large, or a single calyx may be distended and retracted even 3 or 4 inches. Again, the pelvis at the uretero-pelvic juncture may be abnormally broad or square in outline. In case of tumor encroachment, but very little of the pelvic space must remain in order to be able to recognize actual deformity (possibly one or two thin streaks), or if the pelvic space is obliterated by the tumor, nothing would be visible except the collargol within the adjacent catheter. In Fig. 199 but two narrow shadows, one on either side of the encroaching tumor, show all that is left of the pelvis. Thin streaks spreading out into the kidney tissue may be all that is left of the retracted calyces. An interesting feature in such cases is that injected collargol does not readily drain away, as can be demonstrated by radiography several days later, when shadows of the retained collargol will often be shown.

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* Wilson: "Old Dominion Jour. of Med. and Surg.," No. 4, April, 1910.

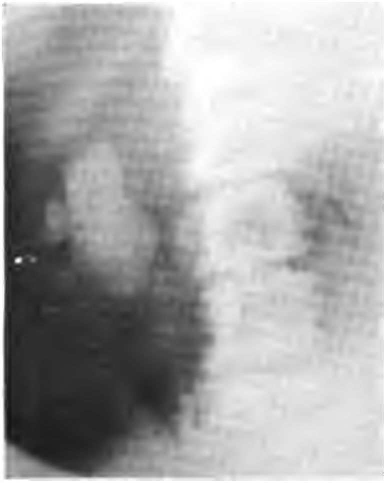

Fig. 196.—A retention or mechanical dilatation of the renal pelvis.

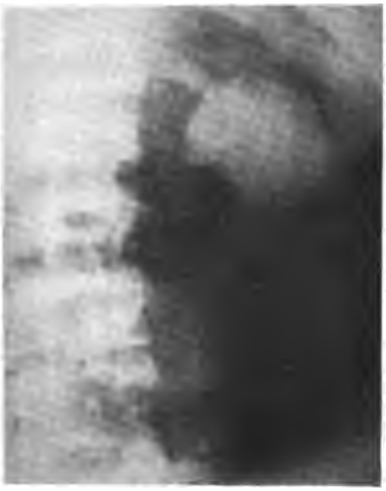

Fig. 197.—An inflammatory dilatation of the renal pelvis.

Another point of corroborative value in suspected tumor of the kidney is to find the pelvis shoved over in unusual positions. In one of our figures it was found lying over the vertebral column. However, it will not be possible to make a radiographic demonstration of distinct pelvic deformity in every renal neoplasm. A large number, possibly a third of them, will not have enough deformity to be of diagnostic value. Again, because of obstruction to the ureteral catheter from various abnormalities in the course of the ureter, external pressure, or even ureteric metastasis, it will often be found impossible to reach the pelvis with the injected fluid. It has been our experience that in order to secure the best results, one should employ a fairly stiff catheter of as large a caliber as possible and radiograph while injecting the collargol.

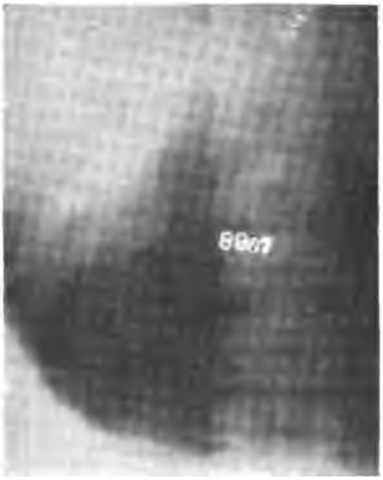

Fig. 198.—A combination of mechanical and inflammatory dilatation.

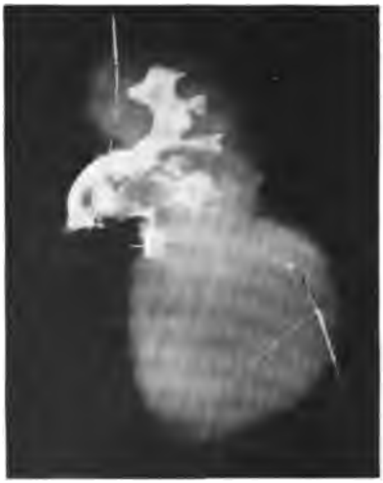

Fig. 199.—The pelvis invaded by tumor tissue, showing but little space remaining.

Localization of Renal Shadows.—While it is true that with good radiographic technic and apparatus the kidney shadow can very often be fairly well outlined, nevertheless for technical reasons in the course of routine examination it will frequently happen that the renal outline is quite indefinite or will not show at all. Moreover, distended gall-bladders, large abnormal livers, abdominal tumors, a large fatty capsule, etc., often obscure the kidney shadow and give misleading ideas of the exact outline and position. While it is very often possible to approximately localize renal stones in the kidney shadow if well defined, we have found that it can be done more accurately with the aid of collargol. A small stone deep in the calyx may, in the unaided radiograph, appear to be in the cortex, while in the collargol plate the cortical stone should usually be seen quite distinct from the pelvic shadow and its relative position in the parenchyma quite accurately ascertained. Pelvic stones will either be obscured entirely by the collargol shadow or show faintly through it. It is true that cortical stones just beyond a calyx may, in exceptional cases, appear to be continuous with the calyx shadow and in it. Furthermore, dilated ends of calyces may appear detached and may simulate cortical stones. Again, a stone in the lateral renal cortex in direct line with the pelvis might appear to be within the pelvis shadow, depending upon the comparative density of the stone and pelvic shadow. Such a lateral position is, however, rather infrequent. If any doubt exists, its position can be ascertained by making the radiograph at various angles. Another possible source of confusion may arise when extrarenal shadows are in direct line with the pelvis and may appear included within it. Nevertheless the stone can be definitely localized by means of the injected radiograph in most cases, which is of much aid to the operator (Fig. 200).

Differentiation of Extrarenal Shadows.—Although the extrarenal shadows can usually be identified as such, it is sometimes difficult to do so. The relation of the injected renal pelvis to a neighboring shadow is often an aid to its identification. This is particularly true in the differentiation of gall-stone shadows. With the development of radiographic technic, gall-stone shadows are being found more frequently. Peculiarities in the shadow will often assist in identifying them. When in a normal position, the distance between the gall-stone shadow and the injected renal pelvis should usually identify them as being extrarenal (Fig. 201). However, when the gall-bladder lies low and overlaps the kidney area, gall-stone shadows appear to be intrarenal, but peculiarities in their relation to the injected pelvis, together with cystoscopic data, should suffice to identify them in most instances. We have been endeavoring recently to employ stereoscopic collargol radiographs in their differentiation.

Ureteral Obstruction.—Obstruction to the ureteral catheter may be physiologic and difficult to differentiate clinically from the pathologic. An actual obstruction which occludes enough of the ureteral lumen to hinder the passage of the catheter usually causes enough urinary retention to produce more or less dilatation of the renal pelvis and ureter above. This can be demonstrated frequently in a collargol radiograph. The method is particularly available in the diagnosis of ureteral stone, which, even with the best technic, will occasionally be missed by the radiograph. At times the obstruction is such that not even enough of the injected medium can pass to cast a shadow. More often, however, enough can be forced by to outline the dilated ureter and pelvis above, even though the catheter itself is blocked. Should the catheter pass

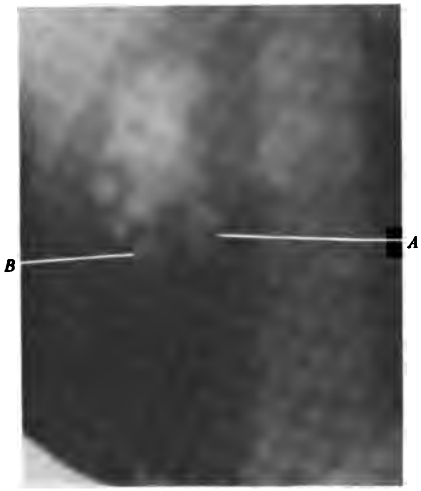

Fig. 200.—*A* and *B*, stones at the ureteropelvic juncture and in a lower calyx respectively. Also a retention hydronephrosis with but little functionating kidney.

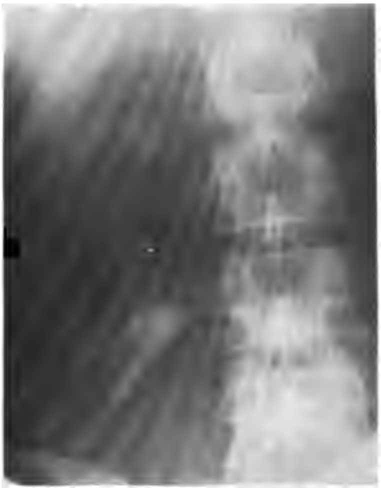

Fig. 201.—The upper shadow is that of a gall-stone; the lower that of a normal pelvis. The distance between identifies the former as extrarenal.

the obstruction, in order to demonstrate the ureteral dilatation, it is advisable to withdraw the catheter almost to the obstruction and then inject. We have several plates where ureteral dilatation involves but a part of the ureter above the obstruction. Again, another plate shows but little dilatation of the ureter above the obstruction, but considerable dilatation of the pelvis. A peculiarity of low-lying ureteral obstruction, and particularly with long-standing or congenital obstruction, is frequently noted in that the first part of the ureter, extending from the ureteropelvic juncture to the first point of narrowing, will often remain undilated even though the remainder of the ureter is much distended (Fig. 202). Because of the difficulty of fully distending a dilated ureter, it may be impossible to outline the full extent of the dilatation. With extreme ureteral dilatation one should first endeavor partially to drain the ureteral contents and then inject a heavy solution of collargol. Profuse return flow alongside the catheter in a naturally flaccid ureter may give the appearance of a moderate dilatation.

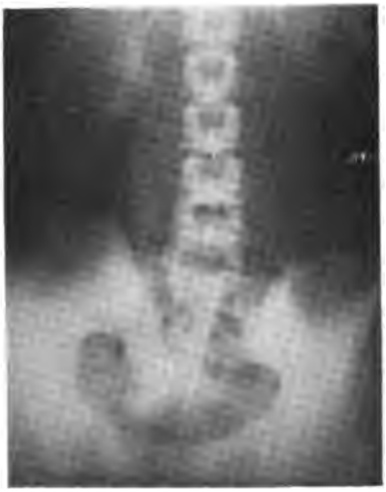

Fig. 202.—A hydro-ureter extending from the bladder to a hydronephrotic pelvis.

Solitary Kidney.—The pelvic outline in solitary kidney may be of diagnostic value. In a plate already published I demonstrated the pelvis of a congenital solitary kidney. The pelvis was shown to be about twice the usual size, but with normal appearing calyces. On exploration the actual size of the pelvis was found to be commensurate with the hypertrophied renal parenchyma. An acquired solitary kidney, on the other hand, when the other kidney becomes functionless, will show a pelvis normal in size and contour. The parenchyma may be double its normal size, but the pelvis remains as it was before. It may be noted with interest that neither of the two cases showed any untoward symptoms following the pelvic distention.

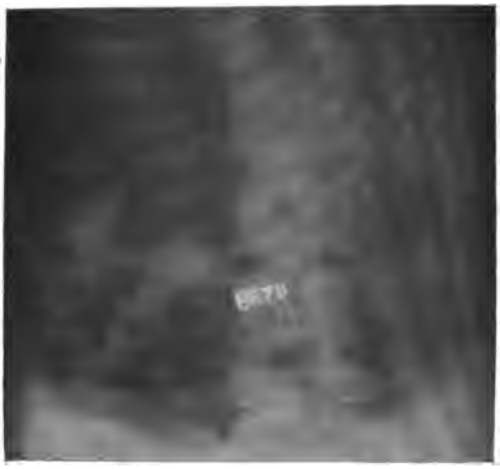

Fig. 203.—The irregular retracted pelvis occurring in a bilateral cystic kidney.

Renal Tuberculosis.—It often happens that a non-tuberculous pyelitis occurs with clinical symptoms, *i. e.*, bladder ulcerations and unilateral cloudy urine, all suggestive of renal tuberculosis. Again, it may happen that a renal tuberculosis infects the bladder mucosa but little, and the clinical and cystoscopic picture may resemble a local pyelitis. It is peculiarly true that a pyelitis will often show a moderate pelvic dilatation in the collargol plate. On the other hand, with renal tuberculosis a cortical abscess or an irregular pelvis and an inflammatory pyonephrosis may often be outlined and of distinct value in differential diagnosis.

Cystic Kidney.—In Fig. 203 we were able to demonstrate the pelvis of a cystic kidney. A clinical diagnosis of unilateral renal tumor was evident. The pelvic outline is similar to that usually found in inflammatory pyonephrosis. The catheterized urine being clear, pyonephrosis was excluded. Diagnosis of a malignant renal tumor could hardly be made from the figure because, (1) a pelvis of such proportions would be the result of a secondary degeneration, and that such is not the case is proved by the clear urine; (2) the outline of a pelvis accompanying secondary degeneration in the malignant renal tumor would be quite different. The irregularly enlarged pelvis was found at operation to be due to retraction of a cortex resulting from diffuse cystic changes.

Congenital Malformations.—The frequency with which fused kidneys and median lying kidneys are found at operation should keep us on the lookout for them clinically. The position of a stiletted catheter, as suggested by Kollischer and Schmidt, would usually suffice to determine anomalous positions in a radiograph. However, the size and shape of the pelves as well as that of the ureters can be outlined in addition to locating them by the injected radiogram. We found a very interesting condition in a plate recently: a moderately hydronephrotic pelvis was seen lying across and to the right of the second lumbar vertebra, with a dilated tortuous ureter leading to the left base of the bladder. The right renal pelvis and ureter were found to be normal in position and size. The plate, which was made stereoscopic, made the lower pelvis appear at a level much more anterior to the right and uppermost pelvis. An interpretation of the plate was rather difficult. We knew that we were dealing with a small hydronephrosis and obstructed ureter, but whether this occurred in a congenital pelvic kidney or in a fused kidney we could not determine. Judging from the distance between the two pelves and the fact that the lower pelvis lay so far anterior to the upper one, we inferred the existence of two separate kidneys as the more probable. At operation a fused kidney 7 or 8 inches in length was found. It had three distinct pelves. The two upper were normal and connected with the ureters which fused above the bladder. The lowest pelvis was found to be hydronephrotic, as demonstrated in the plate, and with a dilated tortuous ureter.

Stereoscopic Radiographs.—We have recently made stereoscopic collargol radiographs which promise to give interesting data. They should be of practical value in the demonstration of shadows at different levels from the injected pelvis. This should be particularly true in the differential diagnosis of overlying gall-stone shadows. Unfortunately, the shadows cast by the organs surrounding the kidney are usually too dim to be of much differential value in the stereoscope.

We have therefore proved quite conclusively that radiograph and cystoscope, working together, make it possible to demonstrate many conditions which either would fail to demonstrate alone. We have frequently found the injected radiograph to be of considerable practical value in demonstrating the following conditions: (1) normal pelvis; (2) hydronephrosis; (3) pyonephrosis; (4) pyelitis; (5) renal tuberculosis; (6) renal tumors; (7) abdominal tumor differentiation; (8) horseshoe and median lying kidneys; (9) solitary kidney (unsymmetric); (10) cystic kidney; (11) differentiation of extrarenal shadows; (12) localization of renal shadows; (13) aid to ascertain renal functional capacity; (14) identification of ureteral obstruction; (15) hydro-ureter.

EXAMINATION OF THE SURGICAL KIDNEY*

By WILLIAM F. BRAASCH

Exact diagnosis of conditions within the abdomen has long been regarded as difficult and often impossible. Until a few years ago our knowledge of diseases of the kidney was scanty and their clinical diagnosis exceptional, but now our knowledge of the surgical conditions is well advanced, due largely to the data acquired at the operating table and through surgical pathology. Clinical diagnosis of these conditions is now probably the most exact in the field of abdominal diagnosis. The operative mortality of renal surgery, formerly prohibitive, has been reduced to 2 or 3 per cent., due as much to the refinement in diagnosis as to our increased knowledge of the various conditions, and improvement in operative technic.

In the clinical examination of the kidney in order to arrive at a diagnosis we have the following means at our disposal: history, physical examination, urinalysis, radiographic examination, and cystoscopic examination. It has been our experience that while we can frequently obtain a general idea of the possible conditions through data from the first three means, it is only through the radiographic and cystoscopic examinations that the diagnosis becomes exact. In fact, the comparatively recent accuracy in renal diagnosis was obtained only through a full employment of the cystoscope and radiograph. Until the technical difficulties which these methods involve have either been simplified or so adjusted as to be at the disposal of the general profession we must necessarily fall back upon a tentative general diagnosis obtained through the history, physical examination, and urinalysis.

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* Read before the Minnesota Valley Medical Association, Mankato, Minn., May 10, 1910. (Reprinted from "The St. Paul Med. Jour.," Nov., 1910.)

The more experience we have with abdominal conditions the less do we rely upon the case history for diagnosis, unless it is positively definite. A pain referred to the kidney zone may really be referred pain from disease in neighboring organs. Pain referred to a kidney may be that of compensatory hypertrophy, while the other kidney is diseased and painless, or it may be due to stone in the lower ureter, and usually without any pain referred to the real seat of the trouble. Total destruction of the kidney substance even may occur without any pain being referred to the affected kidney. However, there are some data in the history of renal trouble which are indicative of the conditions present; among these should be emphasized (1) persistent urinary frequency and (2) hemorrhagic urine. Persistent urinary frequency, and particularly nocturnal frequency, in the young adult should always be regarded as suggestive of renal tuberculosis. In fact, it would be conservative to regard the condition as tuberculosis until proved otherwise. It is well known that the first and often the only symptom of kidney tuberculosis is the irritable bladder, which is infected secondarily. Hemorrhagic urine, on the other hand, while accompanying a variety of conditions in the kidney or bladder, should always be regarded as suggestive of malignancy until the condition can be proved otherwise. Were these simple facts heeded, many patients could be helped through operation in the early stages of the trouble, instead of presenting themselves too late for operative relief.

As regards the physical examination: Palpation is the only method of practical value, and then only in a part of the cases. While it is true that some renal tumors are so large and situated as to be unmistakably felt and recognized as such, there are, nevertheless, many more renal enlargements which, in the first place, are not pathologic; in the second place, they cannot be definitely felt; and, third, they cannot be absolutely differentiated by palpation from tumors of neighboring organs. We must always remember that with one kidney diseased the *well* kidney often becomes congested and hypertrophied and may *feel* like a tumor. Again, there may be tumors of the upper pole, or in high-lying kidneys, which are not felt. Tumors of the pancreas, colon, gall-bladder, and spleen may *feel* exactly similar to tumors of the kidney. Vaginal and rectal examinations are sometimes of value. Stones in the lower ureter and thickened tuberculous ureters may occasionally be definitely palpated by this method. Examination of the adnexa is frequently of value. The percentage of cases of renal tuberculosis in the male with definite tuberculous changes in the epididymis, prostate, or testicle we find to be well over 30 per cent.

Urinalysis.—In the examination of kidney conditions we naturally rely greatly on our findings in the examination of the urine. Our ideas of the comparative value of urinary findings have been markedly changed. We no longer attach much significance to the finding of small amounts of albumin or a few casts. The routine examination of many thousands of specimens of urine has demonstrated their presence to a slight degree in a considerable percentage of the adults examined. The elements which should be considered of practical importance are pus, blood, tubercle bacilli, and the specific gravity. If on microscopic examination we find no pus in the urine, we can practically rule out tuberculosis or any inflammatory process in the urinary tract. In other words, if the patient's symptoms are indicative of kidney trouble, if the microscopic examination of the urine shows no pus present, we can exclude the surgical kidney in the majority of cases. While the negative urine finding is of value in excluding kidney disease, still the positive finding of pus and blood does not identify the kidney as its source. Pus or blood in the mixed urine may come from any part of the urinary tract or vagina, and it is usually impossible to locate its exact source without the aid of the cystoscope. The finding of tubercle bacillus in the urine is nearly always pathognomonic of renal tuberculosis. In every case of persistent frequency it should be looked for. Although the sputum is quite frequently examined for tubercle bacilli, there are correspondingly few examinations of the urine, and it is difficult to understand why this should be so. Certainly the finding of tubercle bacilli in the urine offers no more technical difficulties than finding it in the sputum. The search should be careful and

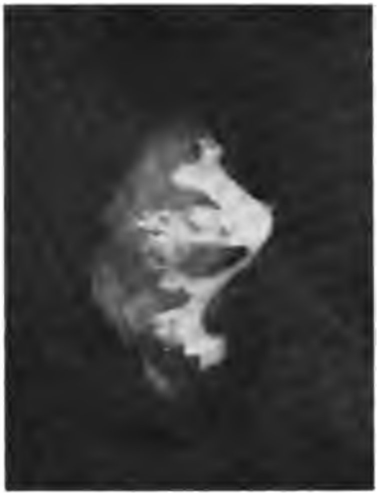

Fig. 204.—Shows the normal pelvis in a postmortem specimen.

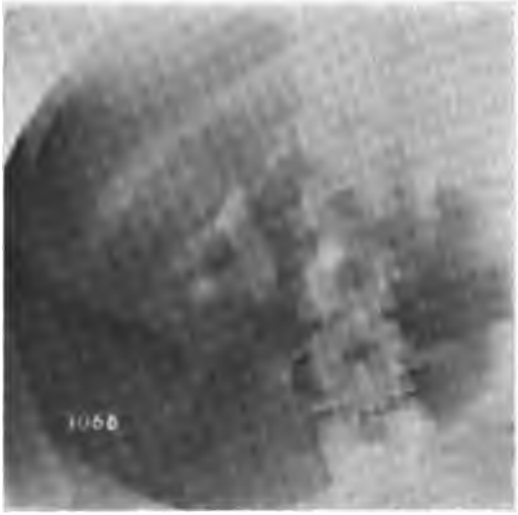

Fig 205. –Shows the normal pelvis in the living.

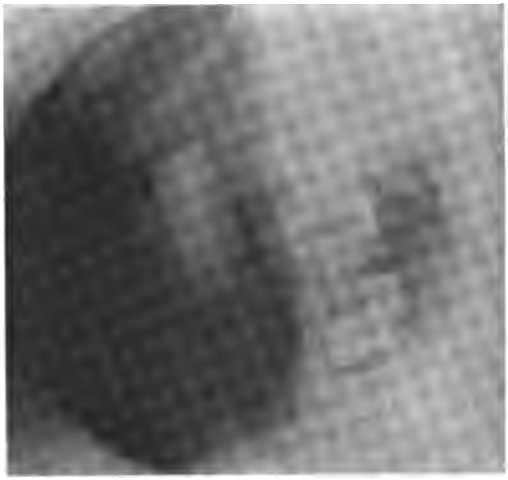

Fig. 206.- Shows a pelvis with a modified hydronephrosis.

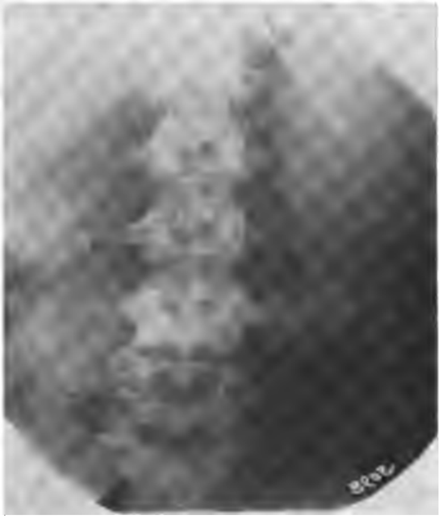

Fig. 207.— Shows the outline frcm a very large hydronephrosis.

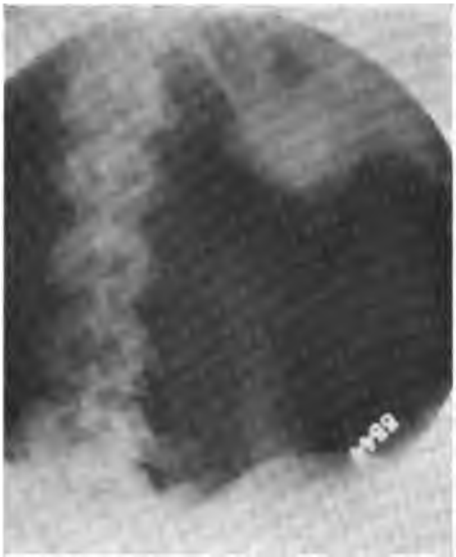

Fig. 208.—Localizes a stone within a dilated pelvis and also shows a hydroureter.

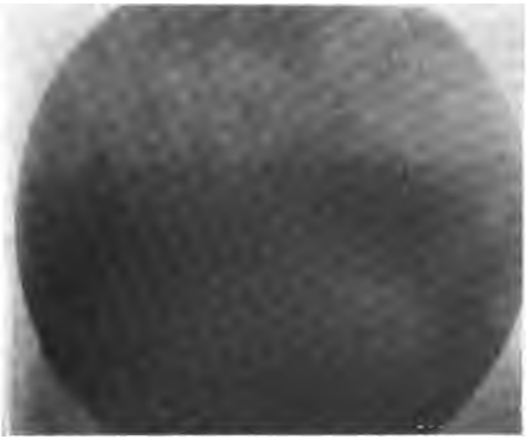

Fig. 209.—Shows a deformity in a pelvis with a hypernephroma.

prolonged; the results obtained are well worth while. It is true that not all acid-fast bacilli in urine are tubercle bacilli; still, if the genitals are carefully cleansed and the urethra irrigated, findings in a catheterized specimen can usually be relied upon. In our experience the bacillus can be found in almost 80 per cent. of the cases. The specific gravity is often of practical import in ascertaining the total functional capacity of the kidneys. Persistent low specific gravity of 1005 or less in several twenty-four-hour specimens, together with other clinical symptoms of renal insufficiency, should be regarded as indicating bilateral renal disease.

Thus it will be seen that we are to a great extent dependent upon the cystoscope and the radiograph for our exact diagnosis in surgical conditions of the kidney. That this is becoming recognized more and more is evidenced by the rapidly increasing amount of work being done with these methods. In fact, so dependent are we upon them that every case of indefinite abdominal pain is radiographed or cystoscoped. The frequency with which renal and ureteral stones are found with the employment of these methods is surprising, when but little in the clinical history would suggest their presence. While the methods have been employed for a number of years, it is only within the last few years that their use has become more general. Both methods are still being developed and perfected, and the data acquired by them are found on operation to be invariably exact and valuable. The value of localization of a stone or of the tuberculous process, and of ascertaining the functional capacity of the kidney, are data of great practical value to the surgeon. His work is, to a great extent, mapped out beforehand, and he loses no time in a search for the seat of the trouble. The advantages to the patient are self-evident.

Without going into further details in describing the technic employed in the use of these methods, I will give a brief description of the more recent advances made. While each of these methods is employed for quite different purposes in renal diagnosis, it has been found, of late, that if they are employed together they aid each other in completing the data obtained independently. Primarily they were so employed by passing a wire stilet through a ureteral catheter up into the ureter, and then radiographing. By this means it was thought that radiographic shadows, indefinite in appearance or situation, could be identified or localized. To render this method more accurate we made stereoscopic radiographs of the stilletted catheter, and thus obtained another dimension in localizing the shadow. A still further development of the combined methods was obtained by injecting a shadow-casting substance, such as silver in the form of collargol, through the ureteral catheter into the renal pelvis, and then radiographing. This was first suggested by Voelcker, of Heidelberg. Last fall, after further developing this suggestion, I reported the results of my investigations before the Society of Clinical Surgery. I have since used the method almost daily, and as a result we now have several hundred plates showing a great variety of conditions.

THE FATTY FASCIAL FLAP IN PLASTIC AND OTHER OPERATIONS ON THE PELVIS OF THE KIDNEY[*]

By WILLIAM J. MAYO

The fine-grained fat lying in the fascia which is closely attached to the kidney, especially about the sinus and pelvis (inner layer of fatty capsule), is very valuable as a covering after operations upon the pelvis of the kidney, and as a means of protecting the suture line in the pelvis of a kidney which has been opened for the purpose of removing stones. The plan of utilizing a fatty fascial flap has been employed for the last three years or more in St. Mary's Hospital, and in the considerable number of cases operated upon there has been no leakage of urine, even when the suture coaptation was imperfect.[†]

Of forty operations for the relief of intermittent hydronephrosis (up to December 31, 1909), in sixteen, plastic enlargement of the orifice of the ureter at the juncture of the pelvis was done, usually after the plan of Fenger,[‡] *i. e.*, a Heinecke-Mikulicz pyloroplasty adapted to this situation. In all the cases in which the suture line was protected in this manner no leakage occurred. (See Figs. 210, 211, 212, and 213.)

In some of the plastic operations just referred to, after the sutures were in place it could be seen that at some points the pelvis was not urine-tight, yet when covered with the fatty fascial flap primary union took place. In three instances the nearly or quite detached ureter, after splitting the end on one side to secure a large opening, was sutured to the dilated pelvis by the two-row catgut suture method, like a gastrojejunostomy. The anastomosed area was then surrounded by a fatty fascial flap, much as the omentum is used in the peritoneal cavity to protect a doubtful suture line. The result was immediate union and permanent recovery.

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[*] Reprinted from "Surg. Gyn. and Obstet.," April, 1910, pp. 363–365.

[†] Mayo-Braasch-MacCarty: "Jour. Am. Med. Assoc., "May 1, 1909, pp. 1383–1388.

[‡] Fenger: "Jour. Am. Med. Assoc.," March 10, 1894, pp. 334–343.

St. Mary's Hospital records show one hundred and twenty-two operations for the removal of kidney stones, up to December 31, 1909. Sixty-nine of this number were performed during the years 1907–08–09, and in all in which the stone was confined to the pelvis of the kidney, pelviotomy was done and the suture line covered with the fatty fascial flap. Rapid convalescence without urinary leakage was in marked contrast to our earlier experience, in which provision for leakage was usually necessary. The certainty of union without the necessity of kidney drainage, or the danger of secondary hemorrhage, etc., has enabled us to substitute pelvi-

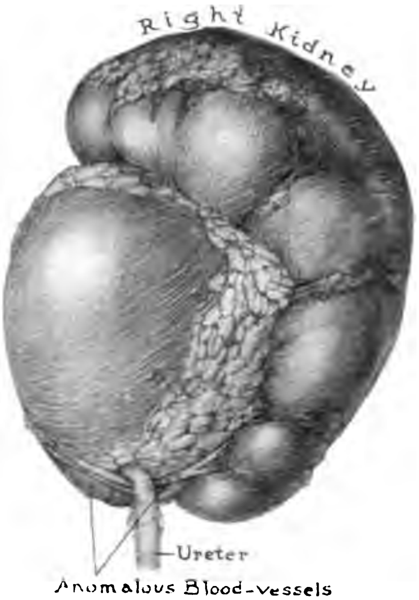

Fig. 210.—Hydronephrosis from kinking ureter, caused by anomalous blood-vessels.

otomy for nephrolithotomy as a method of operation for stone in the pelvis, in nearly all cases.

When operating for stones in the pelvis of the kidney it will often be found that there is considerable increase in the fatty tissue attached to and covering the pelvis. If so, the attached fat is not removed, but the incision is made directly through it as a part of the wall of the pelvis and sutured as a part of the same with No. 1 catgut. Even should the coaptation of the pelvis incision be imperfect, in our experience the fatty covering has efficiently protected against leakage. If the opening in the pelvis is large and irregular from tearing during the removal of a close-fitting rough stone, a flap of the fatty fascia can be made from the vicinity and turned across to protect the closure more perfectly. In one instance the pelvis was detached in three-fourths of its extent from

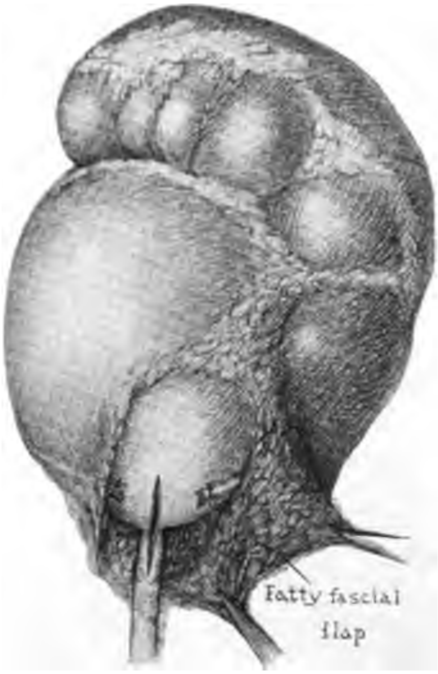

Fig. 211.—Blood-vessels cut and tied. Fatty fascial flap raised and ureteropelvic juncture divided.

the kidney sinus during the removal of a great number of stones from the pelvis and ureter. The patient was obese, the kidney deeply placed, and it appeared as though nephrectomy would be necessary; but the pelvis was sutured back to its position with catgut sutures taking in the kidney substance, and the suture line covered with the fatty fascial flaps. Primary union followed.

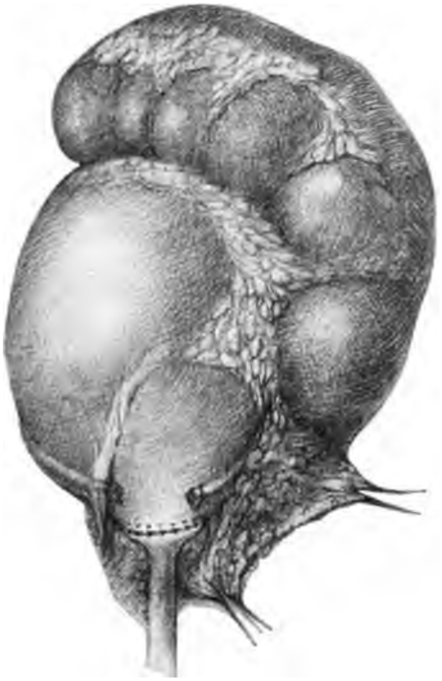

Fig. 212.—Plastic operation on ureteropelvic juncture completed.

In using the fatty fascial flap it is not necessary to suture it closely, but merely to place it over the point to be protected and hold in place with two or three catgut sutures applied in such a manner as to keep the parts in apposition.

For operations upon a kidney which is not the seat of a new growth (unless of large dimensions) we use the posterior oblique incision. The patient is placed prone, with moderate elevation of the loins, exposing both lumbar regions, so that the second kidney can be quickly exposed from behind, if necessary to obtain exact knowledge as to its condition before undertaking a serious operation on the organ primarily affected. The incision is made about 4 inches in extent, starting 2 or 3 inches from the spine above the twelfth rib, extending downward to the iliac crest in a line with the outer border of the quadratus lumborum muscle. If necessary the incision is enlarged and the twelfth rib is exposed and divided behind the angle. In doing this the pleura is sometimes opened, and if this occurs it should be sutured with catgut to the posterior muscles by deep sutures. We have opened the pleura a number of times in such cases, but with the patient lying on the face during operation I have never seen collapse of the lung or any harm follow.

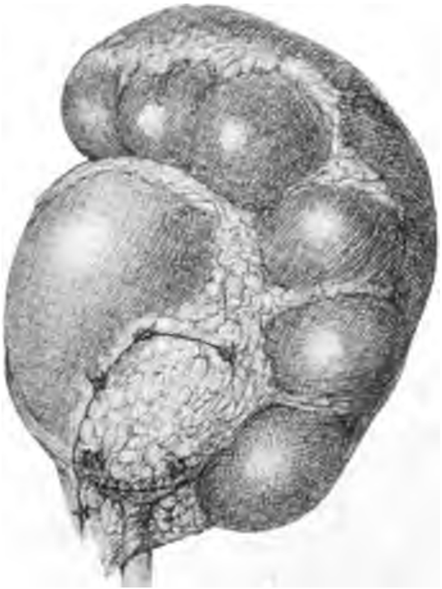

Fig. 213.—Fatty fascial flap in position, and held by a few catgut sutures.

Kelly* justly calls attention to the superior lumbar triangle as a most important landmark in surgery of the kidney. Incision through this space gives ready exposure to the organ.

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* Kelly: "Jour. Am. Med. Assoc.," Jan. 15, 1910, p. 233.

Care should be taken not to divide the ileoinguinal and the ileohypogastric nerves, which run in the line of incision. The kidney is drawn up into the wound and the pelvis and upper ureter are exposed in the kidney notch, usually from behind. In some cases, as shown by Brödel,* the blood-vessels pass to the kidney from behind, and, therefore, the notch is more marked in front. The fatty capsule is stripped from the kidney to the extent necessary to free the organ, and a fatty fascial flap raised either before or after making the working incision in the pelvis. After the operation is completed the fatty fascial flap is placed in position and held by a few catgut sutures; the kidney is replaced and drainage secured by folded strips of rubber tissue, not with gauze, as that might lead to secondary fistula.

* Brödel: "Johns Hopkins Hosp. Bull.," Jan., 1901.

HYPERNEPHROMATA*

By LOUIS B. WILSON

During the eight years ending December 31, 1909, 37 tumors of the kidney have been removed entire, and specimens for microscopic examination have been taken from 3 others, making 40 in all, in the clinic at St. Mary's Hospital, Rochester. One of these was a mixed embryoma, 3 were papillo-adeno-carcinomata, 2 were flat-celled carcinomata secondary to stone, 2 were sarcomata, and 32 were hypernephromata. It is the latter group which I wish to report, at present, seeking only to direct attention to the pathologic changes on which rest the clinical diagnostic data.

Of the 32 cases of hypernephromata, 15 were males and 17 females. All the cases occurred in patients between thirty and sixty-four years of age, there being 7 between thirty and forty, 9 between forty and fifty, 13 between fifty and sixty, and 3 between sixty and seventy years. The left kidney was involved in 14 cases, and the right in 18 cases. There was a definite history of precedent injury over the affected kidney in 4 cases. There was history of pain in the kidney region in 29 cases, arising in 20 of the cases in what was probably a somewhat early stage of the development of the tumor. Twenty-eight cases passed perceptibly bloody urine. In 19 cases a tumor had been noticed by the patient, and in 30 cases it was palpable on physical examination. One of the cases is still in the hospital. Of the remaining 31, 2 have not been heard from since they left the hospital, 10 are known to be dead (3 dying before leaving the hospital, 2 two months after operation, 2 five months, 1 eight months, and 2 two years after operation). The latter 7 all died from metastatic recurrence. Of the 20 cases still alive, 12 have been operated on less than a year, 3 between one and two years, 2 between two and three years, 1 three years, 1 four years, and 1 five years.

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* Read before the Southern Surgical and Gynecological Association, Hot Springs, Va., Dec. 14, 1909. (Reprinted from the "Old Dominion Jour. of Med. and Surg.," vol. x, No. 4, April, 1910.)

Pathologically, the tumors were all apparently primary in the kidney cortex, though in some cases the disease was so far advanced as to prevent an accurate determination of this point.

In the following presentation of protocols I have grouped the cases somewhat with reference to their pathologic anatomy at the time of operation, since in this manner we may be able to compare the findings with the clinical histories of the case. In the first group (15 cases) will be found those cases in which the tumor has arisen at one or the other pole of the kidney, and has deformed to a greater or less extent the pelvis of the kidney from its point of origin as it has advanced in growth. In the second group (7 cases) will be found those cases in which the tumor has developed near the middle of the kidney and has advanced into the renal pelvis from the side. In the third group (2 cases) are those cases in which the tumor, more or less pedunculated, has developed almost wholly outside the kidney substance. In the fourth group (8 cases) are those cases in which the tumor was so far advanced at the time of operation that its initial site was undeterminable.

PROTOCOLS

Group I. (Polar Tumors.)

CASE 1.—(18549.) Mr. N. S., farmer, aged forty-six. About two years ago was kicked by a horse in lower right chest. One and one-half years ago began to pass some blood in urine, then not again until six weeks ago, when hematuria returned, accompanied by pain in back and groin. Has had some irritability of bladder twice, for a week at a time, during the last six weeks. Is now tender in the right side of groin and back. There is a palpable tumor mass in the right side. The urine shows much blood. Fig. 214 shows the tumor to be a very small one in the upper pole of the kidney, producing practically no deformity of the pelvis. There is no extension into the renal vein. The tumor is surrounded by a dense capsule of compressed kidney tissue. Histologically, the tumor is typical hypernephroma. The patient was operated May 21, 1906, and was alive and well without recurrence October 23, 1909.

CASE 2.—(14238.) Mrs. J. H., housewife, aged fifty-two. Well until six weeks ago, when developed sharp pain in right side and back, and two weeks later noticed blood in urine. On examination a palpable tumor mass is found in the kidney region of the right side. The urine shows much blood. The kidney on removal (Fig. 215) shows a tumor of the upper pole, which extends through the kidney substance rather diffusely, having evidently broken past the condensation band of tissue usually surrounding these tumors, and advanced well into the renal pelvis. Section showed rapidly growing hypernephroma with distinct alveolar arrangement. Though the encapsulation of the tumor is perfect at some points, in others the new-growth has passed well beyond any barrier. This patient died two years after operation from metastatic recurrence.

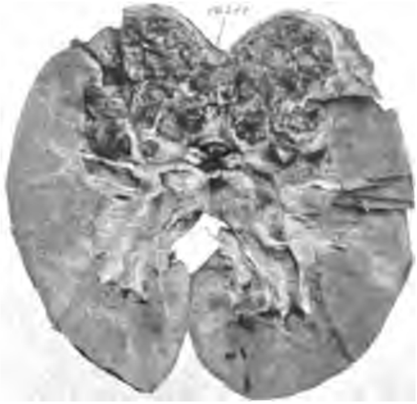

Fig. 214.—Case 1. (18549.)

CASE 3.—(32106.) Mr. B. S., implement dealer, aged fifty-seven. Was operated nine years ago for appendicitis. Nine months ago began passing nearly pure blood in urine; three days after first bleeding another attack, and a third three weeks later. Two months later was examined by physician and no trouble found. For last two months has had almost constant pain in right kidney region. Last week noticed a tumor mass in right side. Has lost 30 pounds in weight within the last six months. There has been no blood in the urine during the last two months, until within the last twenty-four hours; now urine shows much blood. On removal, the tumor (Fig. 216) is found to involve the upper pole of the kidney. It has broken through the kidney capsule and the perirenal fat is involved. The renal pelvis is much deformed. The renal vein contains some of the new-growth. Histologically, the tumor is a typical hypernephroma. This patient was operated upon September 23, 1909. December 23, 1909, reports that he has been in bed all the time since the operation, and has considerable pain in his back.

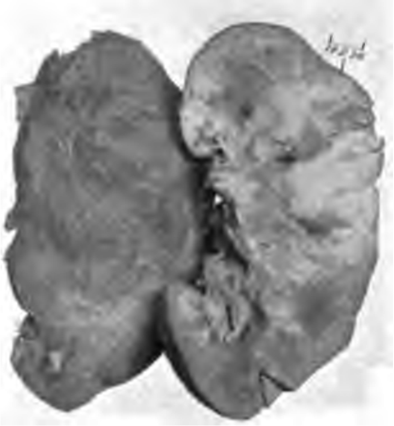

Fig. 215.—Case 2. (14238.)

Case 4.—(29730.) Mr. G. M., real estate agent, aged fifty-one. Fifteen months ago, after severe exertion, noticed blood in urine. Eight hours later, sudden, severe left lumbar pains. Vomited all night, requiring morphin for relief of pain. Was in bed one week after this attack. Partially recovered, but did not feel well again. Had second severe spell of pain accompanied by increase of blood in urine six months ago. At present, occasionally has to use catheter to draw urine; at other times urination is frequent. Pain extends through bladder to kidney. Has lost 30 pounds in weight. Has noticed no tumor mass. On examination a large tumor mass is found in right side. The urine shows much blood. The tumor in this case (Fig. 217) involves the whole upper pole of the kidney, obliterating the upper renal pelvis, which has been correspondingly distended posteriorly. The renal vein at its exit from the kidney is filled with a tumor mass. Sections show typical hypernephroma with loose structure containing many blood-spaces, particularly along the outer border. This patient was operated on April 5, 1909, and was still alive when last heard from.

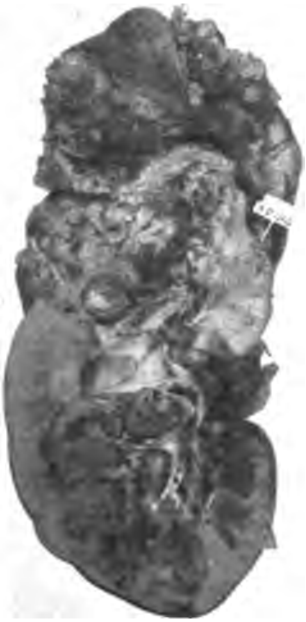

Fig. 216.—Case 3. (32106.)

Case 5.—(32300.) Mrs. B. F. L., housewife, aged fifty-eight. Has two children alive and six dead. Passed menopause twelve years ago. Nine years ago says she noticed a lump in left kidney, which did not appear to grow until two years ago, then began to grow rapidly. Has had a dragging sensation in left side, but no real pain. Has had constipation, apparently from obstruction in the sigmoid. Some blood in the urine during the past four months, when hemorrhage has been sufficiently free to produce considerable weakness. General health has been bad only at times of bleeding. On examination a large tumor is found in the lower left kidney region. The urine shows much blood. On removal the tumor (Fig. 218) was found to be very large, and growing from the middle of the lower pole of the kidney. It has encroached upon the renal pelvis from below, and has invaded, to some extent, the renal vein. Section shows alveolar hypernephroma with very large blood-spaces. Some areas have an arrangement of cells suggesting carcinoma. This patient was operated upon October 5, 1909, and is still alive.

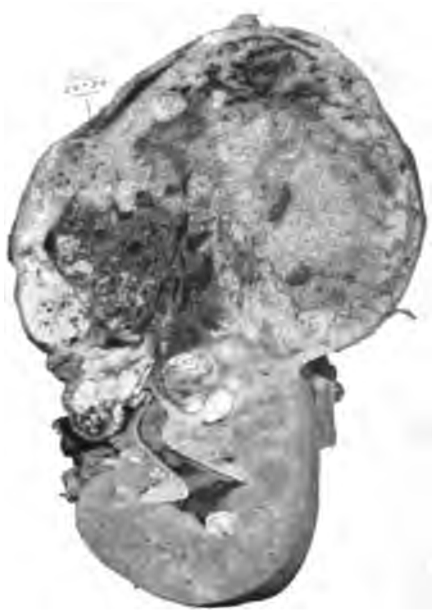

Fig. 217.—Case 4. (29730.)

Case 6.—(28980.) Mr. N. A. F., farmer, aged forty-three. For the past three years has had some pain in right kidney region, and at intervals has noticed some blood in urine. Recently, urine has occasionally appeared to be almost pure blood, clear or in clots. For the last four months had spells of acute pain, commencing over the right kidney and passing downward to penis. After bleeding spells, attack of colicky pains, lasting one hour or so, have been common. During last two months has lost much strength and 25 pounds in weight. On examination a large palpable tumor was found. The urine shows little blood. The tumor in this case (Fig. 219) has arisen near the superior pole of the kidney and advanced laterally, and toward the inferior pole. The pelvis has been much elongated, and though somewhat encroached upon from the side, it is well marked, as though it had been distended. There is no involvement of the renal vein. Section shows typical areas of hypernephroma tissue. Some cells show much fat with crowded nuclei. The thin-walled capillaries have ruptured in many places, giving

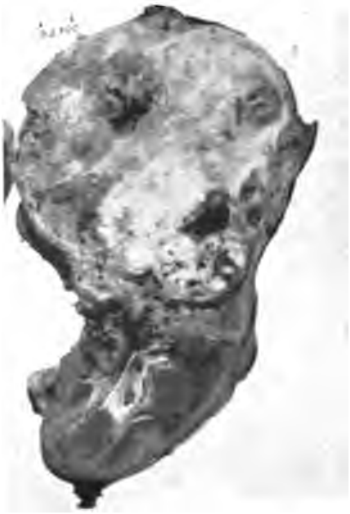

Fig. 218.—Case 5. (32300.)

large areas of extravasated blood. Six months after operation this patient is alive and much improved.

Case 7.—(31867.) Mrs. W. B., farmer's wife, aged fifty-seven. Has four children alive, one dead, and had two miscarriages. Passed menopause nine years ago. Seven years ago began to have pain in left side and back, with dull ache in the left kidney. Two months ago felt tumor mass in left side herself. Says this has grown rapidly since. The urine varies in quantity and has contained blood at intervals for the last two months. Patient has lost about 25 pounds in weight. Examination shows a large palpable tumor in left kidney region. The urine shows much blood. The tumor (Fig. 220) is a large one, involving the whole of the upper pole of the kidney. It has apparently developed first on the upper mesial aspect of the organ, then broken through its capsule laterally and formed a secondary extension of considerable size. Though the tumor is so large and has involved so much of the kidney substance, it has not deformed the renal pelvis as greatly as other tumors of smaller size. Microscopic sections show typical hypernephroma tissue. In many areas connective-tissue stroma

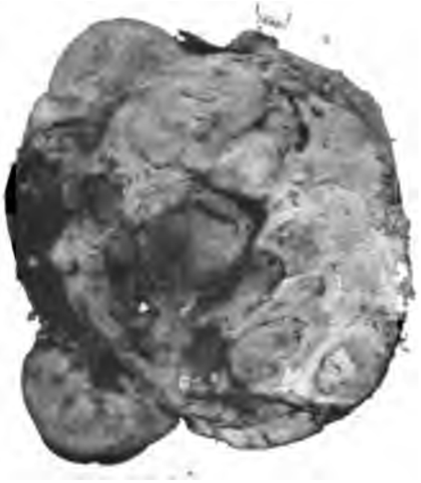

Fig. 219.—Case 6. (28980.)

is in preponderance. To this has probably been due the slow development of the neoplasm. This patient was operated on September 3, 1909, and has been much improved in health since.

Case 8.—(29245.) Mr. L. E., hotel-keeper, aged forty-three. Five months ago noticed a gradual physical decline with loss of weight, loss of strength, and frequency of urination. Three months ago had a severe hemorrhage, "from the bladder," followed by pain in the right kidney region, passing downward to the right testicle. A similar severe attack one month later lasting twenty-four hours. Night urination increased to every hour; day, every two hours. Has lost 25 pounds in weight. The tumor (Fig. 221) involves the lower pole of the kidney and completely fills the renal pelvis. It extends out into the renal veins, which have been dissected off from the vena cavæ. Much of the tumor tissue has degenerated, so that mere outlines of the walls are visible. Other areas show characteristic hypernephroma structure still well pre-

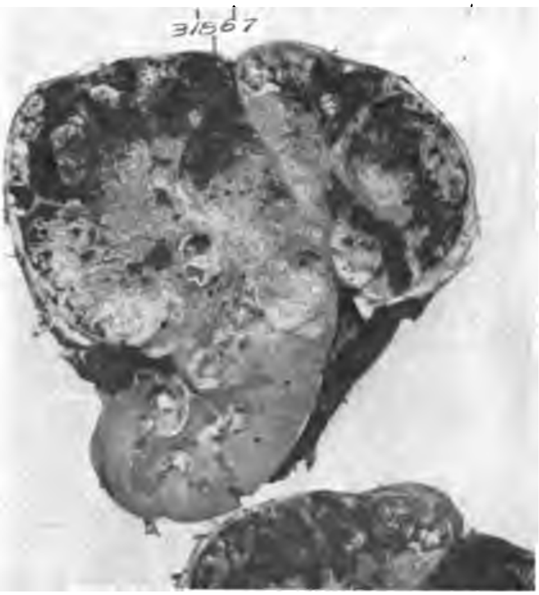

Fig. 220.- Case 7. (31867.)

served. This patient was operated on February 25, 1909, and died December 5, 1909.

Case 9.—(29919.) Mrs. E. H., hardware merchant's wife, aged sixty-four. First noticed a tumor in right side three years ago. Had attack of la grippe six months later, and tumor apparently became smaller. Has had no pain at any time. During the last few weeks tumor has grown larger. Patient has sense of discomfort in right side. No loss of appetite or weight; no urinary symptoms. On examination large palpable tumor mass is found in right kidney region. No blood present in urine. On removal the tumor (Fig. 222) is found to be a large one involving all of the upper pole of the right kidney. It has deformed by pressure the upper half of the renal pelvis. It has not grown into the renal pelvis nor into the renal vein. Its capsule is heavy and apparently has not been passed at any point. Histologically the tumor is a

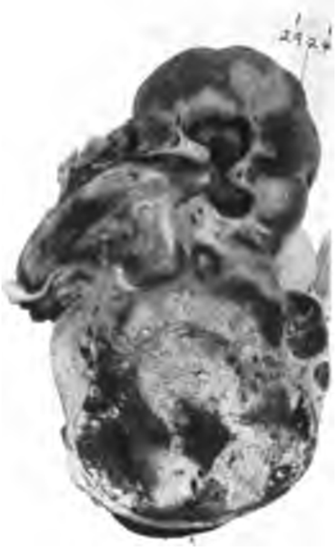

Fig. 221.—Case 8. (29245.)

large degenerated hypernephroma, with the better preserved portions showing a marked papilliferous arrangement of single rows of cuboidal cells along thin-walled capillaries. The patient was operated upon April 17, 1909, and when last heard from, August 4, 1909, was much improved in health.

Case 10.—(22665.) Mrs. S. L., housewife, aged forty-nine; has one child seventeen years old. Thirteen months ago suffered from renal colic, followed by passing blood in urine for a month or more.

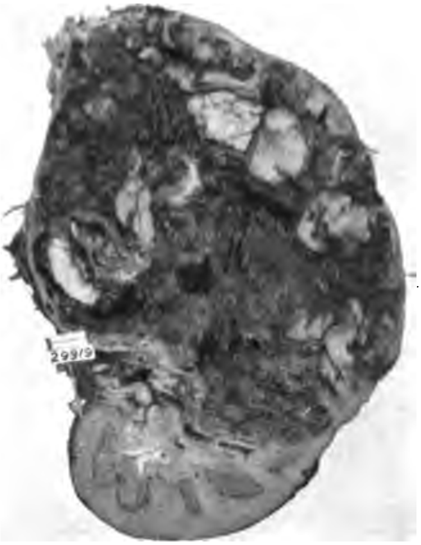

Fig. 222.—Case 9. (29919.)

No further attacks of pain or hemorrhage until three weeks ago; then had a very severe pain for one hour, followed by passage of blood in urine for three weeks. Five months ago discovered hard lump in right kidney region, which has not seemed to have increased in size. Examination shows palpable tumor and some blood in urine. The tumor (Fig. 223) is found to involve all except the upper pole of the kidney. The renal pelvis has been almost completely obliterated. The tumor extends into the renal vein.

Many areas of the tumor tissue show typical hypernephroma arrangement, large blood-sinuses, and many hemorrhages. Fatty degeneration is extensive. The tumor is well encapsulated. This patient was operated upon July 7, 1907, but follow-up letters have brought no reply since.

Case 11.—(30752.) Mr. C. H. A., saw-filer, aged fifty-three. Five years ago patient fell from a horse, striking on left side. Three months later a swelling appeared in left side. This has become larger during the last twelve months. For last four years has had spells of intermittent fever, temperature rising to 103°. These have been relieved by purgation. Two years ago noticed blood in urine for several days. Similar occurrence eighteen months ago. On examination large palpable tumor found in left side. Urine shows but little blood. The tumor (Fig. 224), almost as large as an adult human head, involves the superior pole of the left kidney. The mesentery of the sigmoid is adherent to the tumor. The upper portion of the renal pelvis is reduced to a long, narrow slit, while

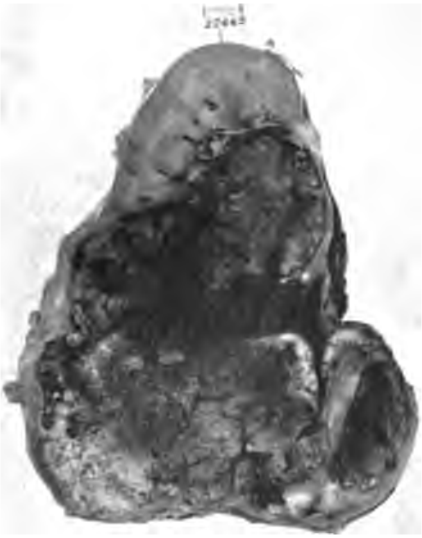

Fig. 223.—Case 10. (22665.)

the lower portion is fairly normal in shape. The renal vein is invaded. The tumor is quite dense in structure, and though showing numerous hemorrhages, it is composed largely of well-staining hypernephroma tissue. The patient was operated June 20, 1909, and died the next day after operation.

Case 12.—(30526.) Mrs. F. L. B., laborer's wife, aged thirty-three. One year ago developed pain over right kidney, especially when working. Pain gradually grew worse. Noticed some blood in urine at intervals during the last year. For past three weeks has lost weight, 22 pounds. Is weak and easily exhausted. First noticed tumor mass over right kidney one week ago. Examination shows palpable tumor. The urine contains no blood. Operation reveals large tumor (Fig. 225) of superior pole of right kidney. The pelvis of the kidney has been completely obliterated by pressure of the neoplasm, which also has invaded the renal vein, as is clearly shown in the cut. Several interrupted capsules (*i. e.*, remains of condensed kidney tissue) are present, showing how the tumor has broken through its boundaries at different intervals, involving from

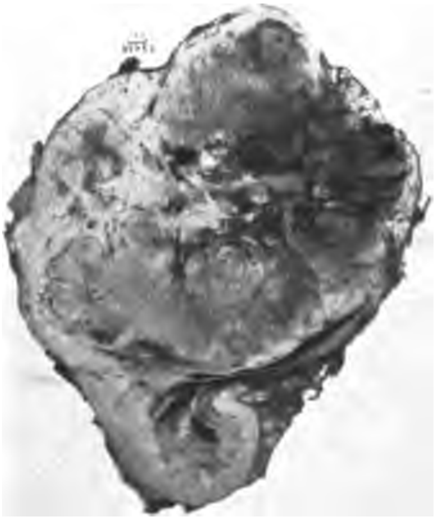

Fig. 224.— Case 11. (30752)

time to time more and more tissue. Microscopic sections show the bulk of this tumor to be of ordinary hypernephroma type, but some areas show typical spindle-cell sarcoma. (See Plate 7, Fig. 6.) This patient was operated on June 17, 1909, and died August 29, 1909.

Case 13.—(25841.) Mrs. J. W. B., farmer's wife, aged thirty-one. Four years ago noticed blood in urine and painful urination occurring twice within a year. Has been troubled similarly at intervals of two to four months since. Bad attack eight months ago, at which time also noticed tumor in region of left kidney. Tumor has been getting larger ever since. Lost 15 or 20 pounds in weight during the last year. Examination shows palpable tumor and much blood in urine. At operation large tumor (Fig. 226) of left kidney is removed. This involves almost the entire

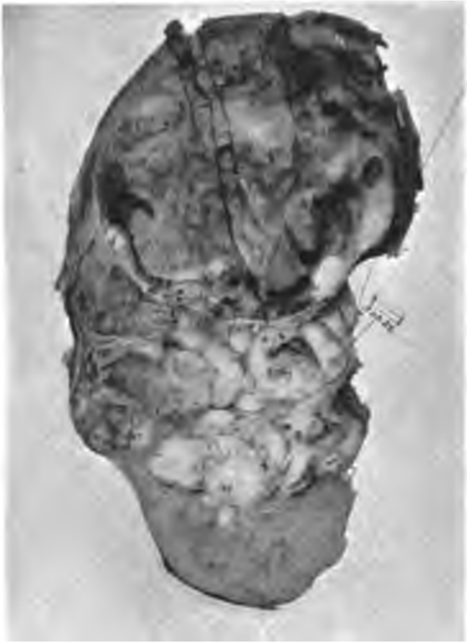

Fig. 225.—Case 12. (30526.)

PLATE 7

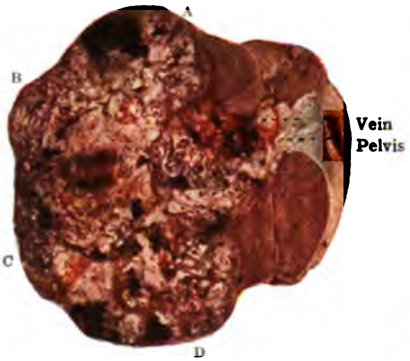

Fig. 1.—(Case 33295)

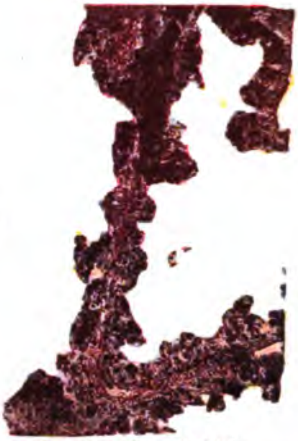

Fig. 2.—(Case 33295)

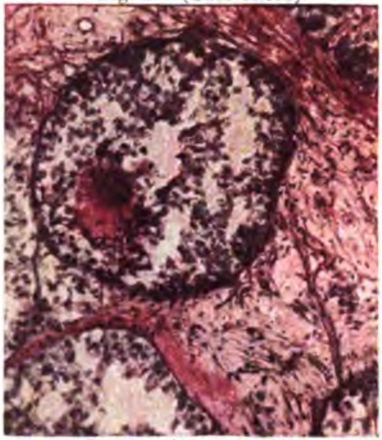

Fig. 3.—(Case 25841)

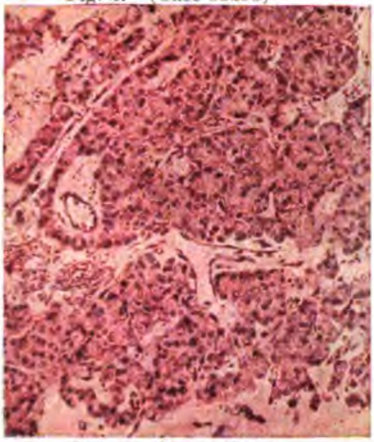

Fig. 4.—(Case 22074)

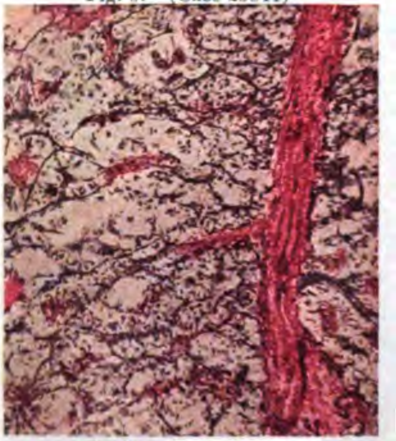

Fig. 5.—(Case 16150)

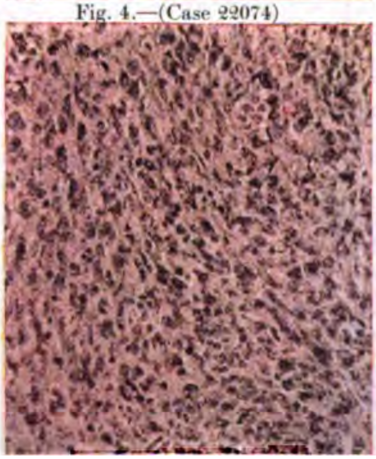

Fig. 6.—(Case 30526)

organ. Its advance is marked off by remains of capsules. The interior is soft and necrotic. The cystic, necrotic center connects with the kidney pelvis. There is no growth of the tumor into the renal vein. The microscopic appearance of the recently developed portions of the tumor is shown in Plate 7, Fig. 3, consisting of epithelial masses within connective-tissue stroma. From the walls of these cyst-like structures project numerous thin-walled capillaries, along the sides of which are arranged the large cuboidal cells, giving a papilliferous appearance to the structure. Some areas show dense columnar arrangement of the cuboidal cells and varying grades of compression of kidney tissue. This patient was operated on May 11, 1908, and when heard from, September 9, 1909, was "feeling fine."

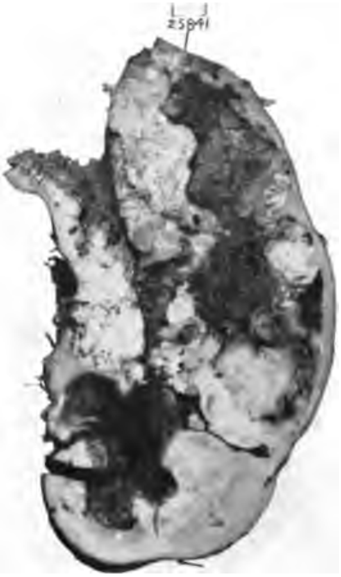

Fig. 226.—Case 13. (25841.)

Case 14.—(27312.) Mr. W. B., owner carriage shop, aged fifty-three. Has had some pain in region of left kidney for a year.

First noticed lump there about nine months ago. Urine has been cloudy at times and micturition somewhat frequent. Examination reveals a large palpable tumor in left kidney region. The urine shows no blood. Operation reveals a very large tumor of the left kidney involving the upper pole and advancing toward the mesial side. The pelvis is almost completely obliterated. There is no growth of the neoplasm into the renal vein. The tumor (Fig. 227), though very large, is well encapsulated, and distinctly separated from the remaining portion of the kidney. Histologically, the structure is much like that in Plate 7, Figs. 3 and 5, the stroma consisting principally of thin-walled capillaries lined with large cuboidal cells. Several large cysts mark areas of hemorrhage and degeneration. This patient was operated December 12, 1908, and August 1, 1909, reports himself well.

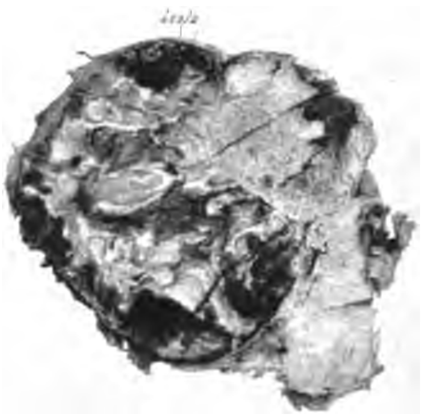

Fig. 227.—Case 14. (27312.)

Case 15.—(27267.) Mrs. A. H. P., housewife, aged fifty-four; mother of five children, youngest twenty-three years of age. Menopause six years ago. At same time had rather free bleeding in urine and a good deal of pain on right side. Four years ago passed blood in urine again, but no pain. Two years ago had rather severe pain and passed a good deal of blood. No hematuria since then.

Has noticed mass in right side for several months. Has heavy feeling of distress in that area. Examination reveals large tumor. Urine shows some blood. Nephrectomy required extensive dissection. There were close attachments to the vena cavæ. The renal vessels were huge. The left kidney was explored and found apparently normal.

The tumor (Fig. 228) had its initial development in the lower pole. Though very large, it had not completely obliterated the renal pelvis. Much of the center of the tumor shows hyaline degeneration. Histologically the tumor shows alveolar arranged papilliferous groups. This patient was operated on September 7, 1908, and was reported well, except for some pain on the other side, December 1, 1909.

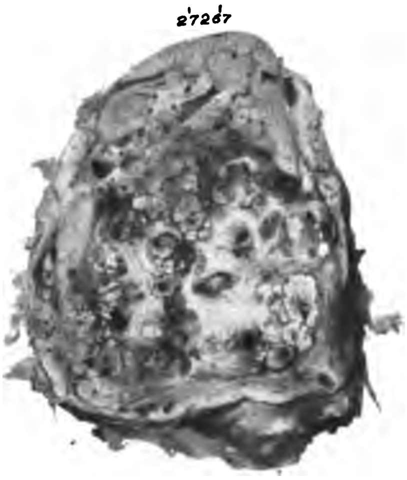

Fig. 228.—Case 15. (27267.)

Group II. (*Tumors from Middle Portion.*)

Case 16.—(33295.) Mr. D. M. B., farmer, aged fifty-two. Three and one-half years ago had typical gall-bladder attack with jaundice. Patient recalls seeing some blood in urine once or twice during past two years. Five weeks ago noticed tumor just below right costal arch. Has no pain nor tenderness, but feeling of weight or pulling. Micturition normal. Eats and sleeps well. Weight normal, gaining a little, if anything, during the past few months. Physical examination reveals hard, firm tumor lying under right ribs, and coming down to level of umbilicus on deep inspiration. Tumor is not through to back, and can be held down with fingers above it on deep inspiration. Urine shows no blood. Exploratory operation reveals large hypernephroma of right kidney.

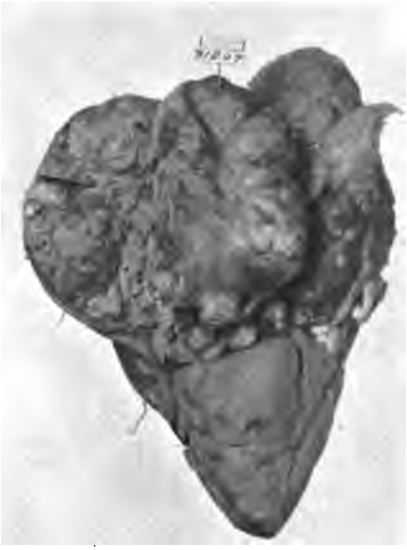

Fig. 229.—Case 17. (31207.)

The tumor (Plate 7, Fig. 1) involves the ventral side of the kidney somewhat nearer the lower than the upper pole. It has pressed upon and deformed the renal pelvis, though not breaking through the pelvic wall. The renal vein is filled with a conical plug of the neoplasm. The color and gross structure of the tumor are accurately shown in Plate 7, Fig. 1, and the histologic appearance in Plate 7, Fig. 2. This patient was operated upon December 28, 1909, and has made an uneventful recovery, though recurrence is to be expected from the involvement of the renal vein.

Case 17.—(31207.) Mrs. H. E. S., glove manufacturer's wife, aged thirty-three. Large, strong, very athletic woman. Has four children, youngest two years. Three years ago had scarlet fever and nephritis. Three months ago began to feel some pain in left side of abdomen and round to left loin. Two months ago got worse for a couple of days, and noticed a little blood in urine. Pain disappeared in a couple of days, recurring again, three weeks ago, for a couple of days, but with no blood noticed in urine. One week ago another attack of pain, and passed a large amount of blood. Weight, good; no fever, chills, sweats, or increased frequency of micturition. Patient under physician's observation

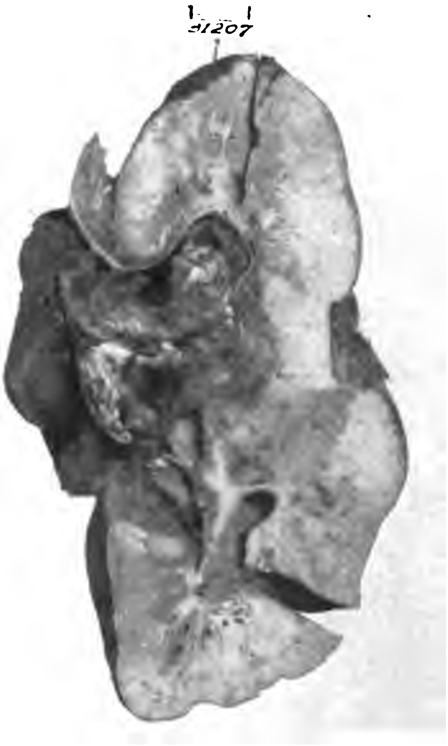

Fig. 230.—Case 17. (31207.) Section.

two and one-half months, during which time two x-ray examinations and two cystoscopic examinations were made; both negative. Ten urinary examinations during time showed small amounts of pus and a very few red blood-cells. Exploratory operation reveals small hypernephroma in left kidney. The tumor (Figs. 229 and 230) involves the middle portion of the ventral side of the kidney. It has grown into and filled the upper half of the renal pelvis and extends into the renal vein. The lower portion of the renal pelvis is normal in size and contour. Histologically, the tumor is a typical hypernephroma. This patient was operated on July 19, 1909, and was reported in fairly good health six months later.

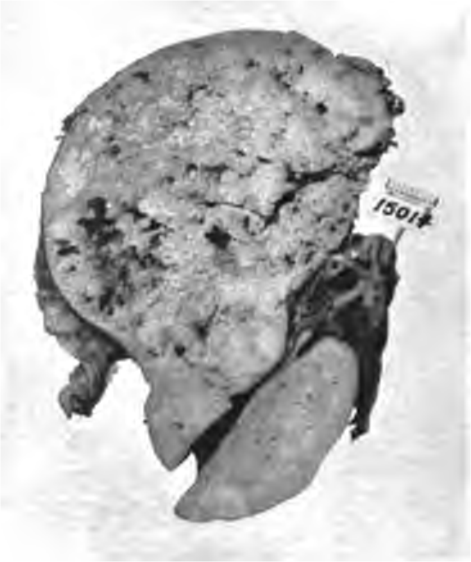

Fig. 231.—Case 18. (15014.)

Case 18.—(15014.) Mrs. C. H., housewife, aged thirty-four. Patient has noticed some dull aching pain in right kidney region for about three months. Thinks she felt a lump in the region about the time pain commenced. Has noticed no blood in the urine. Physical examination reveals a small, freely movable tumor in right kidney region. The urine shows no blood. At operation there was found a tumor (Fig. 231) involving the middle of the right kidney. It has deformed, but not invaded, the pelvis of the kidney, and has not extended into the renal vein. The tumor is thoroughly solid and is composed largely of hypernephroma tissue, similar to that in Plate 7, Fig. 4. This patient was operated on March 10, 1905, and reports herself in good health, August 1, 1909.

Case 19.—(21985.) Mr. J. S., railroad superintendent, aged forty-eight. Four years ago had attack of sharp, stabbing pain over left kidney, which lasted for a few hours, followed by blood in the urine every two or three days. Was in bed one week. Two years later had a second attack similar to preceding one, then entire relief until seven months ago, when he had a third attack. Five months ago he had a fourth attack, followed by marked bleeding and extreme weakness. The fifth and last attack occurred one week ago, when he was in bed two days. Has lost no weight. His general health between attacks is good. Bladder fills with clots which cause stoppage of urine after attacks of pain. Has noticed no tumor. Physical examination shows palpable tumor in the left kidney region. The urine contains numerous small clots of

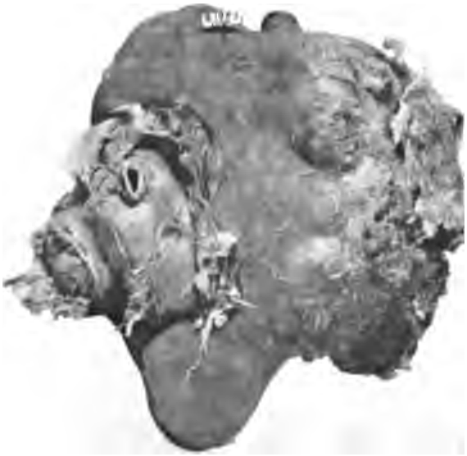

Fig. 232.—Case 19. (21985.)

blood. At operation there is removed a tumor (Figs. 232 and 233) involving the middle portion of the kidney, having apparently arisen from the outer convexity of the organ. It has extended throughout the middle portion of the kidney, leaving only the two poles undisturbed. It fills the renal pelvis, but not the renal vein. This tumor is peculiar in that it contains a number of nodules, apparently completely separated from each other and from the main mass of the neoplasm. Some of these are quite small. One is shown in Fig. 234, magnified 3 diameters. Histologically much of the tissue shows dense, cellular, encapsulated areas. In others the alveolar groups contain looser tissue, with thin-walled capillaries, bordered by cuboidal cells. This patient was operated on May 15, 1907, and reports himself in good health, August 1, 1909.

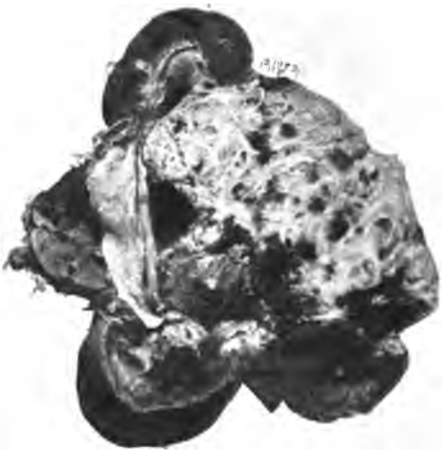

Fig. 233.—Case 19. (21985.) Section.

CASE 20.—(29597.) Mrs. J. McN., machine agent's wife, aged fifty-five. Seventeen years ago had a period of three months of urinary frequency, with pain in kidney region. Recovered under medical treatment. No further trouble until seven weeks ago, when pain returned in left kidney region. Urine has been highly colored at times for years, but no red blood has been noticed until within the last seven weeks. Three weeks ago tumor was discovered by physician in left hypochondrium. Patient has had failing appetite and has lost 25 pounds during last six months. Physical examination reveals large tumor in left kidney region. Urine shows much blood. At operation a large tumor of the middle portion of the kidney is removed. The spleen appears to be twice its normal size. The tumor (Fig. 235) is round with most of its circumference well walled in with dense kidney tissue. At its lower border, toward the renal pelvis, it has broken through, and now invades, as well as deforms, the renal pelvis, and extends into the renal vein. Its central portion shows a large area of hyaline degeneration. This patient was operated on March 23, 1909, and died three months later of metastatic recurrence.

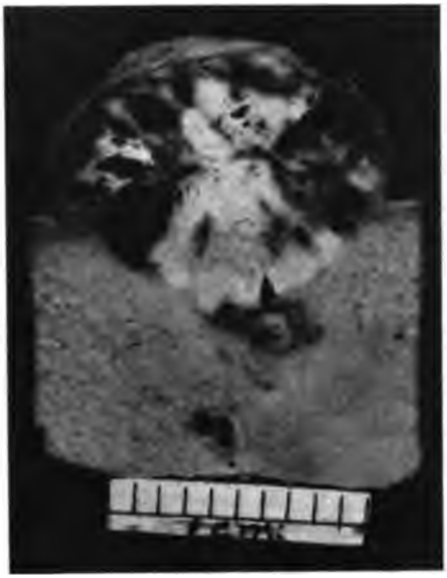

Fig. 21.—Case 234. (21985.) Section, 1 × 3½.

Case 21.—(19216.) Mrs. T. B., farmer's wife, aged fifty-six. Mother of nine children. Two years ago taken with sharp pains low on left side lasting two days. Amount of urine increased and contained blood. Had second attack two years ago, which was like the first, but not as severe. Third attack two months ago; pain has continued more or less ever since. Physical examination reveals palpable tumor mass in left kidney region; urine contains much blood. At operation there is found a large tumor involving the middle portion of the left kidney (Fig. 236). It almost destroys the renal pelvis and invades the renal vein. Its capsule, which is well marked, has been penetrated at a number of points. Histologically the tumor shows many areas of cuboidal cells arranged in columns, and others in which the cells form the true tubules. The patient was operated July 27, 1906, and died November, 1906, of metastatic recurrence.

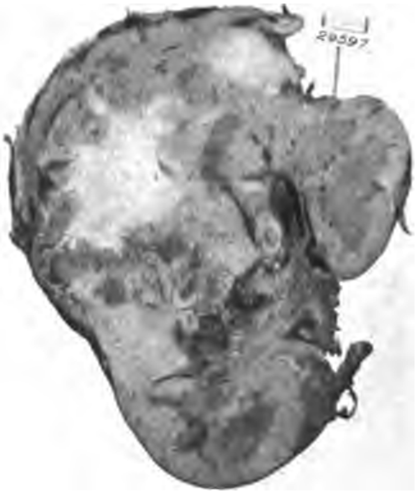

Fig. 235.—Case 20. (29597.)

Case 22.—(19097.) Mr. J. O., hotel-keeper, aged fifty-five. Three years ago noticed reddish color of urine and some small blood-clots; attack lasted day or so. After a month or two of freedom, blood returned in urine again for a day or two. One and one-half years ago a sharp, shooting pain started on left side.

Trouble lasted longer than before, perhaps a week at a time. There is now some pain upon urination when clots appear. Physical examination shows a palpable tumor and much blood in the urine. At operation a very large tumor of the left kidney is removed. The neoplasm (Fig. 237) has apparently started on the ventral side of the kidney, midway between its poles. It has almost completely obliterated the normal kidney tissue, leaving only small lines at either pole. It has involved the pelvis and the renal vein. Most of the tumor is very soft and broken down.

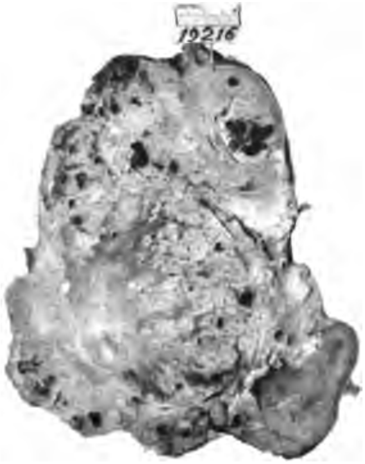

Fig. 236.—Case 21. (19216.)

Histologically the typical alveolar arrangement of thin-walled capillaries, supporting cuboidal cells and contained within a more or less well-marked connective-tissue capsule, is present where the tumor has not completely broken down. This patient was operated upon July 16, 1906. He recovered from the operation, but died two months afterward from metastatic recurrence.

Group III. (Pedunculated Tumors.)

Case 23.*—(8938.) "Mrs. M. F., housewife, aged forty-five. Mother of twelve children, youngest two years old. Twelve years

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* This case has been previously reported. See Herb: "Am. Jour. Med. Sci.," 1905, vol. cxxix, p. 1010.

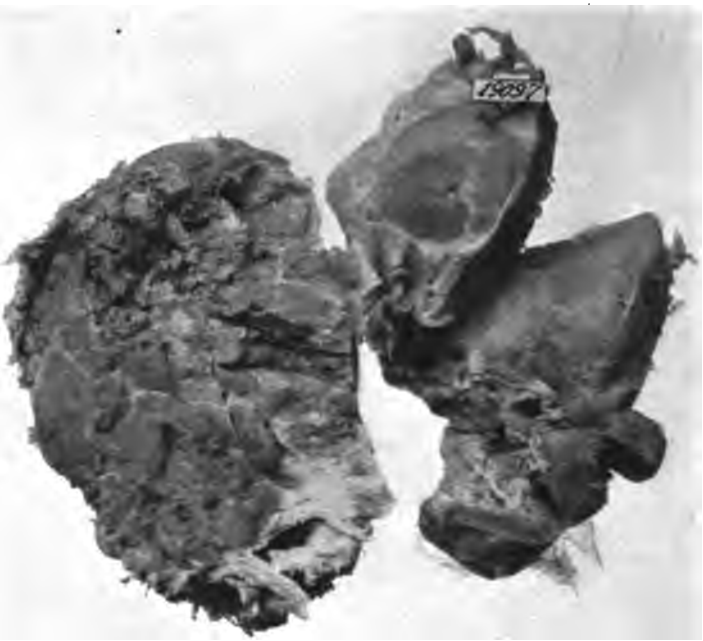

Fig. 237.—Case 22. (19097.)

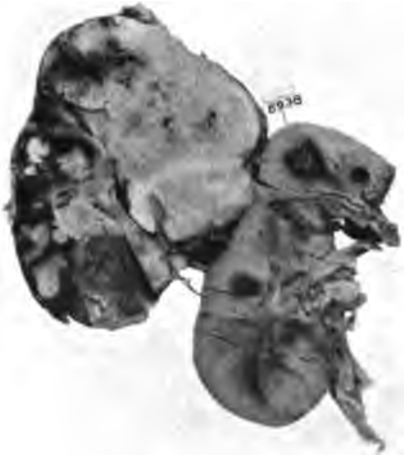

Fig. 238.—Case 23. (8938.)

ago patient was kicked in left side by a cow. Has had occasional attacks of pain in kidney region ever since. Two years ago she noticed an enlargement, and for the past four months has had steady pain in the side. Now has difficulty in moving bowels and trouble with frequent micturition. Physical examination shows palpable tumor in left kidney region. Urine from right kidney is normal in amount and quality; that from left about quarter as much as from right and contains pus and blood." "Springing from the upper pole of the kidney (Fig. 238) and extending into the abdomen is a smooth growth of firm consistency measuring 10 x 24 x 28 cm. It is included in the kidney capsule. The stroma is

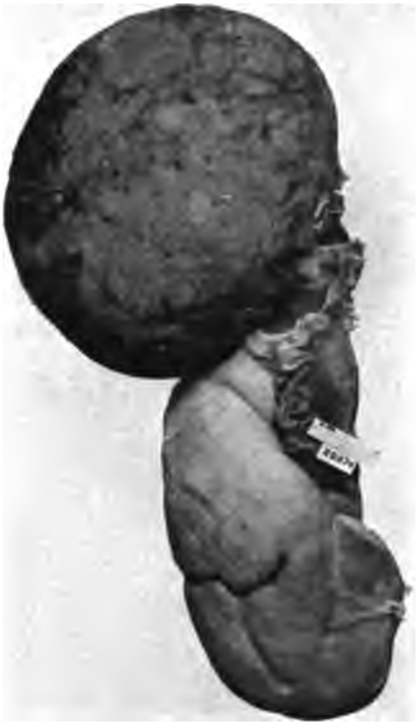

Fig. 239.—Case 24. (22074.)

composed of a delicate network of capillaries, in the meshes of which are round or polygonal cells with a distinct cell wall and a large amount of protoplasm. There are large venous sinuses with well developed walls. This patient was operated upon December 2, 1901. Two and one-half years later there were no signs of recurrence or dissemination."

Case 24.—(22074.) Mrs. T. McM., grain-buyer's wife, aged thirty-five. For the past two years has had attacks of dull pain in right upper hypochondrium with soreness. Sometimes has had sharp pain in abdomen, lower down in appendix region, referred down leg. Five months ago had severe attack of sharp pain in right kidney region, with severe headache and frequency of urination. This attack lasted three days. Since then has had dull pain and soreness in upper right side with a dragging sensation. Discovered a tumor mass in right kidney region five months ago. Operation reveals tumor attached to upper pole of right kidney. It simply indents (Fig. 239) the kidney without being attached, except by fibrous connective tissue, to the organ. The gross structure of this tumor resembles the more dense portions of the hypernephromata previously reported. Histologically (Plate 7, Fig. 4) it consists of bands and columns of cuboidal cells arranged about thin-walled capillaries. The suprarenal was apparently normal. It is difficult to determine from examination of the specimen whether it is a tumor of the suprarenal or of the kidney proper. Aside from the absence of degenerated areas it is a counterpart of the other tumors herewith reported. This patient was operated on May 24, 1907, and July 28, 1909, reports herself in good health, having passed successfully through pregnancy, beginning six months after her operation.

Group IV. (Initial Site Undeterminable.)

Case 25.—(17995.) Mrs. H. W., railroad employee's wife, aged thirty-four. One year ago developed sharp, lancinating pain over left kidney region. Some pain at all times since, with frequent exacerbations. Noticed some blood in urine four months ago. Physical examination shows large tumor in region of left kidney. Urine shows no blood. Operation reveals large tumor (Fig. 240) involving whole of kidney to such an extent that its point of origin cannot be determined. The renal pelvis is involved, but the renal vessels slightly, if at all. Some areas show microscopically alveolar groups of typical hypernephroma cells, but much of the tumor is in an advanced stage of fatty and hyaline degeneration. This patient was operated on March 19, 1906, and died August 5, 1908, of metastatic recurrence.

CASE 26.—(13524.) "Mrs. S. McD., housewife, aged sixty-four. Mother of five children. A year and a half ago began to pass bloody urine. First attack lasted four days, two others not so long. Pain at this time referred to bladder region. Recovered and felt fairly well for one year. During last six months has had more or less pain in bladder. Two months ago noticed tumor in right side, which has rapidly increased in size, but is not especially sensitive. On physical examination large tumor mass in right side was palpated. The urine from the left kidney was normal and none was being excreted on the right side." Operation reveals large tumor involving the entire kidney. Section (Fig. 241) shows group of lobules more or less separated from each other by bands of connective tissue. Many of these show the hypernephroma tissue in advanced stages of fatty or hyaline degeneration. A few contain well preserved tissue in which the alveolar arrangement of

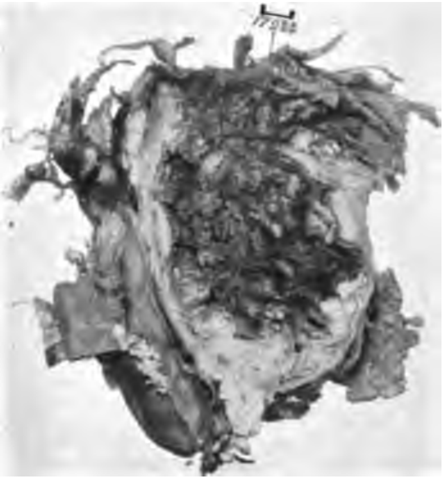

Fig. 240.—Case 25. (17995.

cells is well marked. Patient was operated upon July 6, 1909, and died seven days after the operation.

Case 27.—(13937.) "Mrs. H. P. R., housewife, aged sixty-one. Has passed bloody urine for ten years. Noticed an abdominal tumor four years ago, which she thinks has increased fully one-half in size in the last six months. Complains of dull pain for last four years, starting in right side and extending to suprapubic region. Physical examination reveals a large palpable tumor in right kidney region. A mixed specimen of urine contains pus and blood. That from the left kidney is normal. Some pus and blood with no urine obtained from right kidney." At operation a very large tumor involving the entire kidney is removed. On section (Fig. 242) this tumor shows a similar gross structure to that in Case 25. Degeneration, both fatty and hyaline, is well marked. Histologically, except in degenerated areas, there is typical alveolar arrangement of hypernephroma cells resting on thin-walled capillaries.

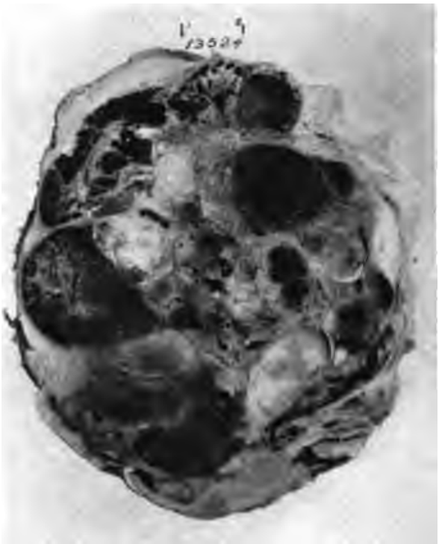

Fig. 241.—Case 26. (13524.)

CASE 28.—(31968.) Mr. A. J. B. Fell from a bicycle five years ago. Noticed blood in urine shortly afterward, which lasted a few days. Then well until one and one-half years ago, when again noticed blood in urine, and had pain in right kidney region. Has had more or less pain constantly ever since, with two or three periods of blood in the urine. Has noticed no tumor. Has

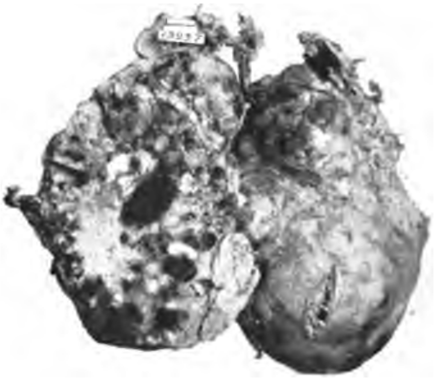

Fig. 242.—Case 27. (13937.

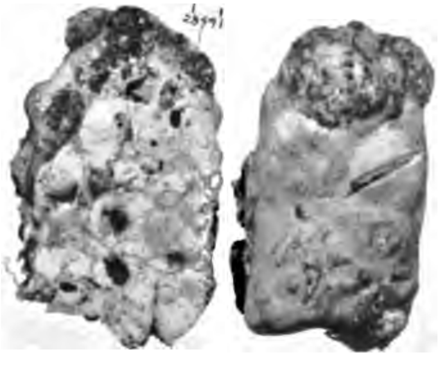

Fig. 243.—Case 28. (31968, 28441.)

become weak and lost weight, about 25 pounds. Physical examination shows no tumor. The urine contains blood. Operation shows large tumor of right kidney involving entire organ. Section of the tumor (Fig. 243) shows a large, degenerated tumor. Some areas still show fairly typical hypernephroma arrangement. The patient was operated September 10, 1909, and November 20th patient reports himself in good health, having gained 20 pounds in weight.

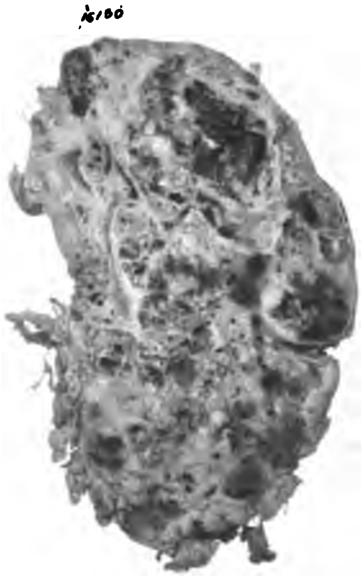

Fig. 244.—Case 29. (16150.)

Case 29.—(16150.) Mr. J. S., farmer, aged sixty-four. Two years ago began to pass some blood in urine. This stopped after a short time. Nine months ago began to have pain in left side. This was worse at night. Has never noticed any tumor. On physical examination a very large tumor in the left kidney region is made out. The urine shows much blood. On account of weak condition, the patient is advised not to submit to operation, but insists that he be given the possible chance.

Operation reveals very large tumor involving the entire left kidney, extending into the renal vessels and involving their walls to such an extent that it is almost impossible to form a stump. The tumor is adherent to the surrounding tissues and the capsule is highly vascular. Section of the tumor (Fig. 244) shows its structure to be much degenerated. Histologically, aside from degeneration, there are some areas which show alveolar arrangement with numerous blood-vessels. The wall and a portion of one of these is shown in Plate 7, Fig. 5. Thin-walled capillaries, on which rest cuboidal cells, forming papilliferous projections out into the cyst-like structure are clearly shown. This patient was operated on August 4, 1905, and died eight hours after the operation. Autopsy showed death to have occurred from hemorrhage from the mesh-work of much distended vessels, which had been connected with the capsule of the tumor. There were numerous small metastases in the liver and in abdominal lymph-glands.

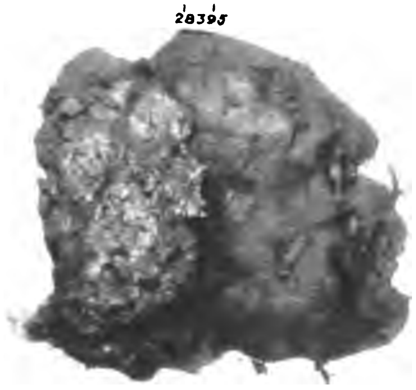

Fig. 245.—Case 30. (28395.)

Case 30.—(28395.) Mr. O. G., lumberman, aged thirty-one. Eight months ago began to pass blood in urine. This was accompanied at times by colicky pains. Had four or five such attacks with short duration, but gradually dull pain became prevalent all the time. Blood in urine three months ago. Has been in Lumbermen's Hospital last thirteen months for treatment. Has lost 12 or 15 pounds in weight. Is weak and run down. There is a large palpable tumor in the region of the right kidney and the urine shows some blood. Operation reveals a tumor which involves the entire kidney and has broken through the capsule of that organ, projecting in a fungoid mass (Fig. 245) into the abdomen. Section of the tumor (Fig. 246) shows it to be of a papilliferous character in some areas, and in others dense and solid, though much degenerated in structure. The renal pelvis is much encroached upon; the vessels appear to be free. Histologically there are many areas showing typical hypernephroma tissue. Other areas are indistinguishable from ordinary spindle-cell sarcoma, and similar to that shown in Plate 7, Fig. 6. This patient was operated December 15, 1908, and was alive and in fairly good health August 15, 1909.

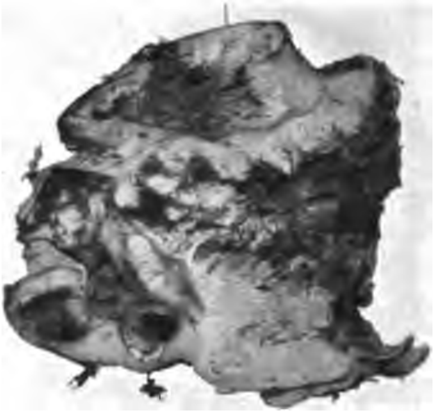

Fig. 246.—Case 30. (28395.) Section.

Case 31.—(18748.) Mr. H. C. S., farmer, aged forty-six. Six years ago began to have pain in back and right side. Blood appeared in urine, which frequently contained clots. The pain at times was very severe, causing nausea and vomiting. At times voids large quantities of urine, after having passed small clots for a day or two. Has never noticed any tumor. On physical examination a very large tumor is palpable in the region of the right kidney. The urine contains much blood. Exploratory operation reveals large tumor of right kidney so adherent to adjacent structures as to be inoperable. Small piece of tissue removed for examination shows typical hypernephroma, and one area resembling round-cell sarcoma. Though the entire tumor is not removed, a diagnosis of hypernephroma is warranted from the gross appearance of the tumor, and from the test specimen removed. This patient was operated on June 9, 1906, and died two months after return home.

CASE 32.—(30897.) Mrs. D. J. McM., cigarmaker's wife, aged forty-three. Patient has had stomach trouble (*i. e.*, distress after eating, bloating, sour eructations, vomiting of food, etc.) for the last eight years. Sometimes great pain two or three hours after meals. Has had pain over right kidney during past year. First noticed a lump in the right side eight months ago. Physical examination reveals large tumor in right hypochondrium. The urine shows no blood. Operation reveals very large tumor of the kidney, extending well up behind liver, which organ is elevated. Tumor has gross appearance of hypernephroma. Piece removed for microscopic examination shows hypernephroma. Patient was operated on June 29, 1909, and is reported alive and somewhat improved in health October 18, 1909.

Summary.—An examination of the preceding protocols and the accompanying illustrations will serve to make plain the pathologic reasons for certain points important to the diagnostician and surgeon.

1. The small solid tumor well away from the renal pelvis is likely to cause no hematuria and no pain. From such there should also be no venous metastases. Since they are apt to be symptomless their surgical discovery is an accident. But granting that all hypernephromata probably pass through such a stage, the nearer we can come to recognizing it, the better it will be for the patients.
2. Small amounts of blood in the urine usually come from the kidney side of the condensation "capsule" of the tumor. Large renal hemorrhages are from the thin-walled capillaries of the tumor where it has broken through the capsule into the kidney tissue, or into the renal pelvis.
3. The compression by the tumor of the remainder of the kidney, of the renal pelvis, or of adjacent nerves, as well as the presence of clots in the ureter, explains the various types of pain.
4. Tumors of the superior pole are apt to cause the more early distortion of the renal pelvis, and apparently also earlier and more pronounced pain, owing to the relationships of liver and diaphragm.

5. Tumors of the mid-ventral side of the kidney are apt to develop slowly and cause only slight amounts of hematuria and pain.

6. Tumors of the lower pole may be large enough, before the kidney tissue is all destroyed, to block the ureter and cause varying degrees of hydronephrosis.

7. The renal pelvis may be encroached upon from above (Group I), from below (Group I), or from the side (Group II). In either event there is more or less of a compensatory enlargement in other directions, even where no ureteral obstruction is demonstrable. On the other hand, there may be no deformity of the renal pelvis (Case 1 and Group III), or it may be entirely obliterated (Group IV). These points are of importance in interpreting the Röntgen pictures of the renal pelvis made after collargol injections, a method of diagnosis so satisfactorily developed by my colleague, W. F. Braasch.*

Early extension of the tumor into the renal vein may temporarily lessen the pressure in the renal pelvis. The capsule of the portion of the tumor projecting into the vein is apt to be very thin. Extensive renal vein involvement at the time of operation usually means the early death of the patient from metastatic recurrence.

A further study of the morbid histology and the comparative embryology of these tumors will be presented in a subsequent paper.

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* Braasch: "Annals of Surgery," Phila., 1910, li, 335–542.

A COMPARATIVE STUDY OF THE HISTOLOGY OF THE SO-CALLED HYPERNEPHROMATA AND THE EMBRYOLOGY OF THE NEPHRIDIAL AND ADRENAL TISSUES *

By LOUIS BLANCHARD WILSON, Assisted by BYRD CHARLES WILLIS

Introductory.—During the past eight years 34 tumors of the kidney, which we are accustomed to call hypernephromata, have been removed at operation in the Mayo clinic, St. Mary's Hospital. In studying these and 14 other cases (48 in all) from the University of Minnesota I had for some time gradually come to notice more and more certain discrepancies between the facts observed and Grawitz's hypothesis of their origin from adrenal rests. Last year, while reviewing these cases, and preparing them for publication from the pathologico-surgical standpoint, this impression was much strengthened. At this time also in going over the literature I found the excellent article of Stoerk, which had previously escaped my attention, but which fully established me in many of my previous doubts. Indeed, this paper arrays in most masterly manner a mass of facts and arguments against Grawitz's hypothesis, while at the same time adducing much evidence to show the tumors to be of renal origin.

There remain, however, other characteristics of the tumors which still appear incompatible with our conception of adenomata or carcinomata derived from kidney tubules. In an attempt to clear up these points I have recently reviewed, both in the literature and in the tissues, certain phenomena of the embryologic development of the nephridial and suprarenal tissues.[1] In the latter study I have had access to the embryologic collections of Thomas G. Lee, University of Minnesota, G. Carl Huber, University of Michigan, Charles S. Minot, Harvard University, and of Franklin P. Mall, Johns Hopkins University. But for the many courtesies extended by these gentlemen my embryologic work would have been impossible, and to them I am most deeply indebted.

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* Read before the American Association of Pathologists and Bacteriologists, May 3, 1910. (Reprinted from the "Jour. of Med. Research," Jan., 1911.)

B. C. Willis has performed the large task of preparing the pathologic material and grouping the data concerning the tumors.

I wish to present herein a brief review of the pathology of the Grawitzian tumors, and to add thereto certain observations on the embryology of the kidney which seem to me to make clear certain obscure points concerning their origin.

REVIEW OF LITERATURE

Grawitz[2] first called attention to the fact that these tumors in their structure are analogous to the suprarenal gland. He noted the macroscopic aspect and described their development in cordons of from four to eight cells, which he says are the size of the gland-cells of the breast and contain one or two nuclei.

As suggesting their origin from adrenal rests he notes:

1. *The Seat of the Tumor.*—They are situated immediately beneath the kidney capsule, a point frequently invaded by wandering suprarenal cells.

2. *The Character of the Cells.*—They are absolutely different from the epithelium of the uriniferous tubules.

3. *The Fat-content of the Cells.*—Fat is normally absent from the renal epithelium, but frequently present in the suprarenal.

4. *Encapsulation of the Tumor.*—This capsule is similar to that which is found around "suprarenal rests" within the kidney, but which are not changed into tumors.

5. *Relation of the Tumor-cells to the Surrounding Tissues.*—The cells which are analogous to the suprarenal cortex are disposed in more or less regular cordons, while in the central region of the tumors there is evidence of fibrous tissue resembling the medulla of the suprarenals.

6. *The Presence of Amyloid Degeneration in the Tumor.*—This hypothesis of Grawitz was accepted and confirmatory evidence supplied by a host of observers during the next quarter of a century. About the only critic of note within this period was Sudeck,[3] who held that the Grawitzian tumors had nothing to do with adrenal rests, but were renal adenomata. He described their development from an atypical proliferation of the epithelium of the kidney tubules and noted that the tumor consists largely of cells which are not separated from the wall of their supporting capillaries by connective tissue. Sudeck's views received little support, though from time to time observations were recorded which tended to throw doubt on Grawitz's hypothesis. One of these was that of Greer and Wells,[4] who, in a careful chemical examination of hypernephromata, failed to find any trace of adrenalin.

Adami,[5] in discussing broadly the classification of tumors on an embryogenetic basis, states his opinion "that whereas aberrant adrenal tissue is, from its heterotopic nature, more prone to become blastematous, and whereas it may well be that a large number of the kidney tumors of this type are hypernephromata, others are nephromata. . . . When a tumor of the kidney shows a special liability to form tubules rather than solid cell masses, we would suspect a renal rather than an adrenal origin. . . . The two organs (adrenal and kidney) are embryogenetically so closely related that *tumors arising from homologous tissues must possess closely related characters.* Where, as is most frequent, but by no means constant, one of these growths arises from the upper pole of the kidney, the probabilities are that it is of adrenal origin. . . . For all this order of tumors, the transitional adenoma, carcinomata of adrenal, kidney, ovary, and testis, we have, from embryogenetic considerations, suggested the term *mesothelioma.* Briefly a mesothelioma is:

"1. A tumor arising from such tissues or portions of organs as, being of mesothelial origin, possess in the adult state lepidic characters.

"2. When typical, and growing slowly, it is of purely adenomatous type.

"3, When atypical or more anaplastic, and growing rapidly, it reverts first to an alveolar sarcomatous type, and later to a structure, or want of structure, which renders it indistinguishable from a round or even a short spindle-cell sarcoma.

"4. The tumor, when it takes on this undifferentiated type, affords metastasis of sarcomatous order. The primary growth, in general, if studied, exhibits indications of the successive stages through which it has passed, from the adenomatous to the sarcomatous form of growth."

Stoerk,[6] who bases his statements on "many years of study of more than 120 specimens of renal tumors from operations and autopsies," begins his paper with a statement of his support and extension of Sudeck's views.

He pertinently asks: "Why do Grawitzian tumors always develop from the kidney and never from the adrenal? Why do tumors developing on the adrenal gland always look so different from Grawitzian tumors? Why, in the face of the legion of adrenal rests found in the liver, is there not a single case of hypernephroma of the liver established? As to Grawitz's alleged topographic agreement of the adrenal rests and the tumors: The whitish particles in the cortex of otherwise normal kidneys are found to have a predilection for the cranial pole passing to the hilus. Grawitzian tumors also have a topographic predilection zone, but it embraces a wide band in the middle of the kidney. (Küster[7] noted that of 194 Grawitzian tumors, 80 were in the middle of the organ, 60 from the lower pole, and 54 from the upper pole.)

"Much of the so-called fat content of the Grawitzian tumors is of a peculiar hydropsical swelling of the protoplasm, a vacuolation related to glycogen content. The double refraction of the fat-like substance has been found by Löhlein[8] in the protoplasm of the kidney epithelium. The double refracting substance of the adrenal cortex and that of the kidney under pathologic conditions are absolutely unidentical.

"Papillary formations, which so frequently appear in Grawitzian tumors, are a strong argument against their adrenal origin. Papillary formation needs a free surface from which, and a cavity into which, sprouting can take place. These conditions are wanting in the adrenal and its primary tumors. The human adrenal forms neither in a physiologic nor in a pathologic manner under any circumstances whatever either a tubular or cystic epithelial arrangement.

"Can proliferating kidney tissue yield lumenless formations? Regenerative increase of the kidney parenchyma is shown in the compensating hypertrophic kidney.

"Regenerative parenchyma formation of the kidney is limited to the new formation of canaliculi. This is intelligible in two forms: First, through lengthening of the existing canaliculi, and second through their ramifications. In this way two pictures are produced: the first, an expression of a rapid growth process, shows straight tubules; the second is a striking deviation from the quiescent canaliculi, both in the unusual width of its lumen and in the regular contouring of its epithelium. Masses so formed in certain granular contracted kidneys form little pale protuberances of the kidney surface.

"Only a part of the smaller kidney protuberances are of the type just described. Others are adenomata, though in the same protuberance both types may occur.

"Every cyst formation of the kidney can lead to papillary growth. From my own experience I am not in a position to say whether there is a pure tubular carcinoma of the kidney."

Stoerk next proceeds from the typical pictures of the Grawitzian tumors to attempt to establish the connection between them and regenerating kidney.

"In the affected kidney the Grawitzian tumor is plainly set off from its surface. Microscopically such tumors give an unexpected abundance of quite different histologic pictures. The most familiar and most characteristic is the alveolar type with swollen cells. In its alveolar structure, cell groups of similar dimensions lie between passages of vessel-bearing stroma. This stroma occasionally is reduced to a minimum, so thin in fact that the cells appear arising upon the capillaries or vessel walls directly. There is nevertheless almost always a perivascular connective-tissue sheath to be demonstrated. We see transverse or longitudinal oblique sections of cell bands of nearly cylindrical shape. Occasionally the vertices of the cells surrounding the tubule show characteristic hyaline droplets. I do not hesitate to call the process existing in the middle of solid or apparently solid bands a kind of secretion. It is not always easy in individual cases to decide whether the appearance is that of a preëxisting lumen or subsequent lumen formation upon a secretory basis.

"The foregoing has shown that the type of tumor apparently solidly alveolar throughout can be recognized, by careful examination, as a tubular as well as a papillary growth.

"The hypothetic order of development of Grawitzian tumors is probably: (1) kidney contraction; (2) papillary cystoma; (3) Grawitz's tumor."

Stoerk's summary is as follows:

"1. Between hypernephrogenic and nephrogenic tumors no kind of convincing agreement exists.

"2. The different forms of Grawitzian tumors are shown histologically as varieties of one and the same fundamental type.

"3. The Grawitzian tumors of the kidney are of renal origin.

"4. Whereas the 'Blastem tumoren' are characteristic of childhood, the Grawitzian tumors are found mostly in the second half of life. This occurrence of Grawitzian tumors in later life is quite intelligible in relation to the origin in contraction processes.

"5. The tumors under discussion should be designated adenomata, papillary cystomata, or carcinoma of the kidney after the Grawitz type."

The contribution of Jelle[9] presents six tumors, two being almost altogether formed by cellular cordons, three containing clearly tubular structures, and one which contained cordons, cysts, with arborescent papillæ, tubular formations with clear openings, and an adrenal adenoma situated immediately underneath the capsule of the tumor. Although all six of his tumors possessed a capsule, cordons, and clear cells rich in fat, Jelle does not think this evidence sufficient to establish a suprarenal origin. He notes the difficulty in determining the point of origin of advanced tumors. In regard to the character of the fat content of the cells, he considers it impossible to differentiate microscopically the fat of the hypernephromata from that of cancer of the kidney, either by polarization or staining. Indeed, the only difference which he has been able to observe in any renal or suprarenal structures as to the fat content is that in autochthonous cancers of either organ the cells are less rich in fat. Jelle concludes: "Thus in spite of the contribution of Grawitz on the one part, and of Stoerk on the other, it appears impossible for us to decide, from the insufficient histologic groups, the origin of the tumors. If we were required to pronounce definitely on the six cases which we present, we would estimate that only the two first could be considered as tumors of suprarenal origin."

Trotter[10] presents a hypernephroma whose histology agrees with Stoerk's statements in showing tubule formation, etc.

PERSONAL OBSERVATIONS

Concerning the location of the tumors, my series show 12 to have arisen from the upper pole, 14 to have arisen from the middle portion of the kidney, 10 from the lower pole, and in 12 cases the exact location was indeterminable. The frequency with which the polar tumors arise exactly from the apex of the pole rather than slightly to one side is noticeable. This is shown in Fig. 247. I am inclined to think that, of the tumors arising from the middle portion of the kidney, more arise from the dorsum than from near the hilus; at least this is so in our series, so far as can be determined.

All the tumors in this series have well-defined capsules on their external surfaces and "condensation capsules" between the renal parenchyma and the tumor. In some of them the capsule has been broken through one or more times. This is shown in Fig. 248. It is noticeable that each successive capsule consists of less and less fibrous material. Indeed, in most of them in only the original capsule can marked fibrous structure be made out. That the capsule consists entirely of the fibrous stroma remaining after destruction of the kidney parenchyma is not always true.

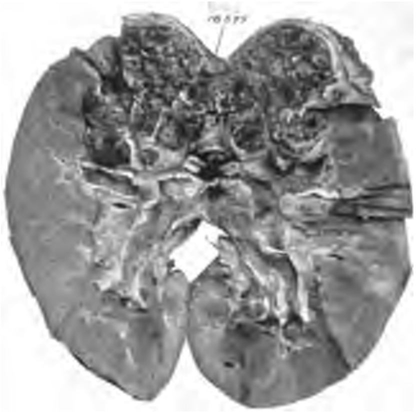

Fig. 247.—(Case 18549.) Early hypernephroma, showing tumor in superior pole of kidney.

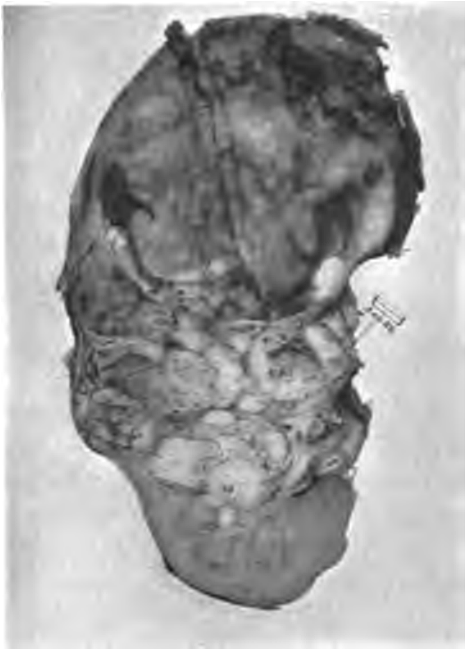

Fig. 248.—(Case 30526.) Showing breaking through of successive capsules by "hypernephroma."

In some the fibrous connective tissue is much more marked than would be produced by such a process, unless it were augmented by secondary overgrowth. The character of the capsule and its penetration are shown in Fig. 249. Fibrous transformation of central parts of the tumor is quite frequent, and is no doubt due, as Stoerk has pointed out, to connective-tissue organization of hematomata. Three of our cases are of multinodular type, and a careful examination of them established no relation between the nodules. They had apparently each developed from a separate center of origin.

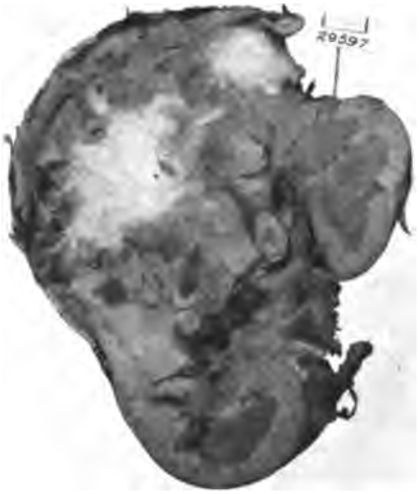

Fig. 249.—(Case 29597.) Showing character of the capsule and its penetration; also fibrous transformation of center of tumor.

Of our 48 tumors, 36 show marked papillary formation, an example of which is given in Fig. 250. Forty-five of the cases show tubule formation in greater or less extent, and it has not been excluded in the other three. This is very marked in 38 of the tumors, forming, indeed, the chief portion of the structure. Even in those which show almost wholly dense cordon formation one will come across well-defined tubules in certain areas. Examples of this are shown in Figs. 252 and 252. In the cases which show

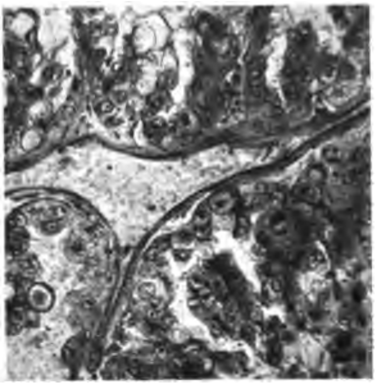

Fig. 250.—(Case U. 1047. × 200.) Showing papillæ formation.

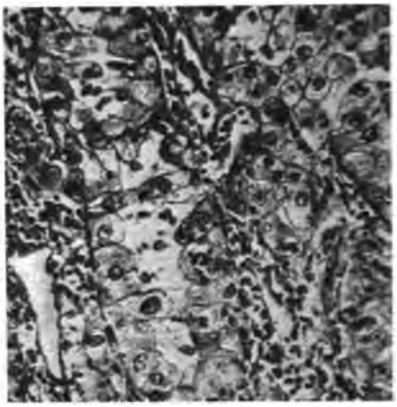

Fig. 251.—(Case 31207. × 200.) Showing beginning tubule formation.

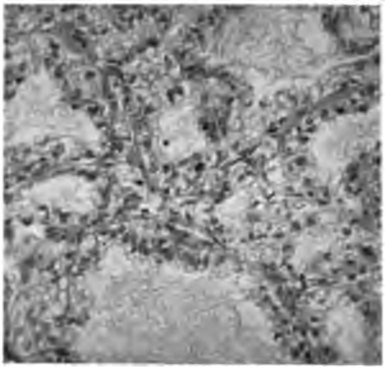

Fig. 252.—(Case 21985. × 200.) Showing advanced tubule formation.

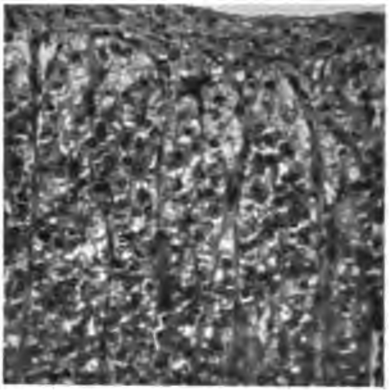

Fig. 253.—Adrenal cortex. (× 200.) Showing cordon formation of adrenal.

most perfect cordons there is still a very great difference between the cords and similar structures in the adrenal. The adrenal cordons are broad, regular, evenly packed, but unpressed; the tumor cordons are short, irregular, and usually much compressed. The relationship of these is shown in Figs. 253 and 254. The large swollen cells of the tubular structures with their highly placed nuclei are quite like those described by Stoerk. This character of the cell is even more accentuated in the papilliferous areas. Some of these are found in Fig. 255.

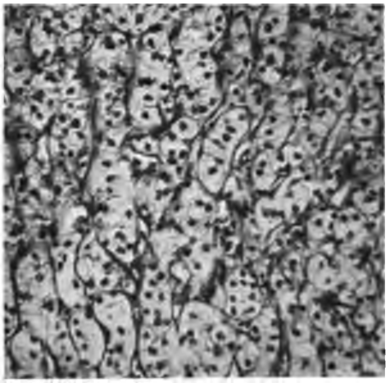

Fig. 254.—(Case 29597. X 200.) "Hypernephroma" cordons.

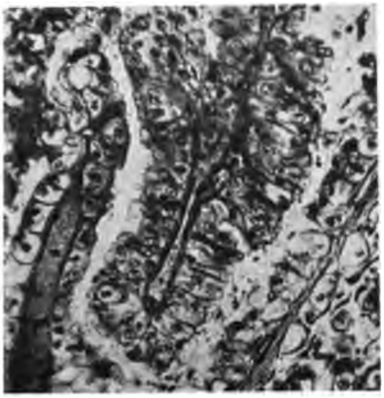

Fig. 255.—(Case U. 1047. X 200.) Tubules with high-placed nuclei.

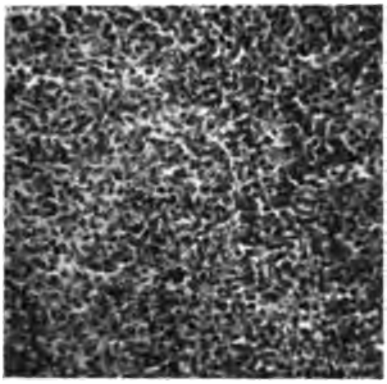

Fig. 256.—(Case 14238a. X 200.) Sarcoma-like area.

Two of our cases, however, are in contradiction to Stoerk's statement "that the spindle-cell tissue is quite completely wanting." In these two tumors, both of which show cordon formation, lumen formation, and papillæ formation, there are also areas which show typical spindle-cells, indistinguishable in any particular from that of ordinary spindle-cell sarcoma. One of these is shown in Fig. 256. One case which shows cordon formation, lumen formation, but no papillæ, presents several large areas which, if seen alone, would warrant a diagnosis of round-cell sarcoma. In two cases, which contain likewise tubules, cordons, and papillæ, are also found groups of cells which, in their somewhat flattened appearance, type of staining, small fat-content, and method of infiltration into the surrounding tissue, would, if examined apart from the other portions of the tumor, warrant a diagnosis of carcinoma. They have been compared most carefully with carcinomata arising primarily from the renal pelvis and associated with nephrolithiasis. None of our tumors have been found to contain cartilage, bone, or muscle tissue, though they have been studied in relation to tumors of the Wilms type, which contain one or all of these structures.

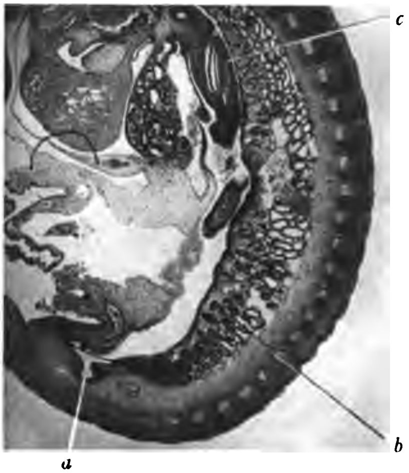

Fig. 257.—Sagittal section of embryo (S81-4-18-×15). Showing: (*a*) Renal bud, from Wolffian duct, with nephrogenic tissue surrounding it; (*b*) Wolffian body; (*c*) site of later development of adrenal.

In general it may be said that from both an anatomic and a histologic standpoint my observations fully confirm the first two of Stoerk's conclusions, viz.: First, "Between tumors of the adrenal and tumors of the kidney no kind of convincing agreement exists." Second, "The different kinds of forms of Grawitzian tumors are histologically varieties of one and the same fundamental type."

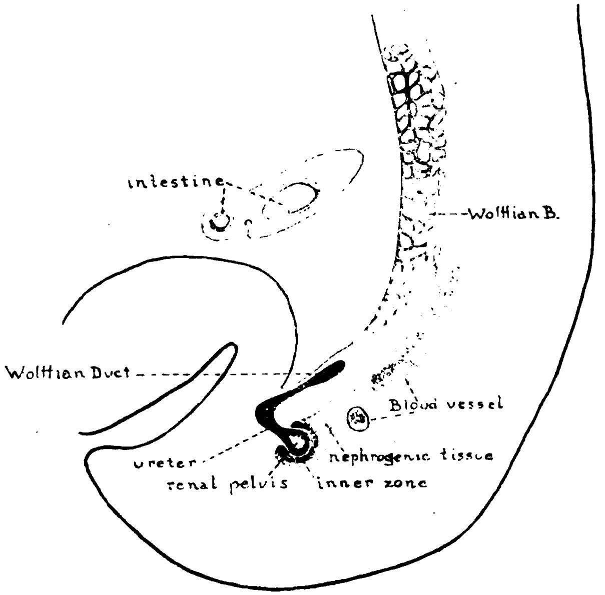

Fig. 258.—Human embryo, 6.6 millimeters. (Mall 371, -5-16.)

With regard, however, to his third conclusion, that the Grawitzian tumors of the kidney are derived from convoluted tubules, I am not prepared to agree. The following points are worthy of further consideration before we abandon entirely Grawitz's hypothesis and accept Stoerk's that the tumors are of renal tubule origin:

1. Are the so-called adrenal rests as frequent in the kidney as is

generally supposed by pathologists? If so, is it not fair to suppose that their stimulation may not produce overgrowth at some period in the history of the individual?

2. Why do the Grawitzian tumors, though so well encapsulated, always show such high malignancy? That this is so is abundantly proved by their short clinical histories, and the usual fatal termination of the cases.

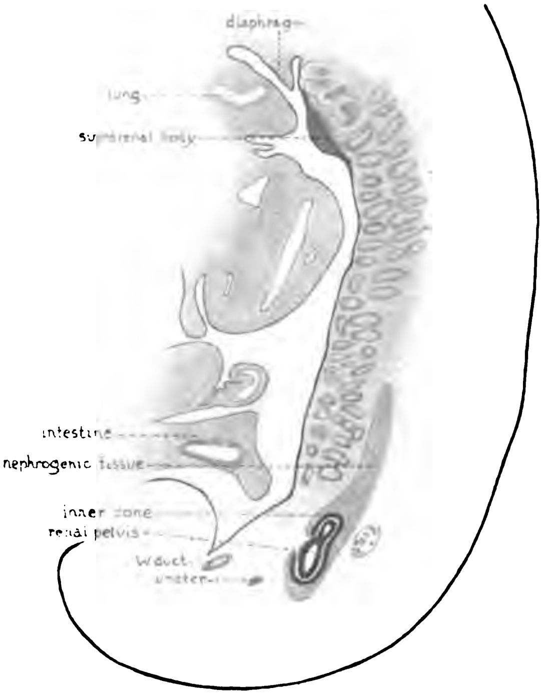

Fig. 259.—Human embryo, 10 millimeters. (Huber 2, -12-1.)

3. Why are almost all of the Grawitzian tumors so markedly different histologically from autochthonous renal carcinomata, *e. g.*, those arising from more or less distal portions of the renal pelvis?

4. Why is usually each Grawitzian tumor of mixed histologic type—adenoma, carcinoma, papilloma, alveolar, sarcoma, spindle-cell sarcoma, etc.—if they arise from renal tubules?

5. Why do their metastases follow the sarcoma type, while the carcinomata of the renal pelvis follow the ordinary glandular course of dispersion?

With regard to the frequency with which true adrenal rests occur within the kidney I have long entertained considerable doubt. When one examines microscopically the small, whitish, ovoidal masses which are encountered underneath or within the kidney capsule, he is struck with the resemblance of most of them to the remains of the Wolffian body. Indeed, there is reason to doubt whether any of the so-called adrenal rests within or beneath the kidney capsule are really of adrenal origin, when one considers the embryologic development of the two organs.

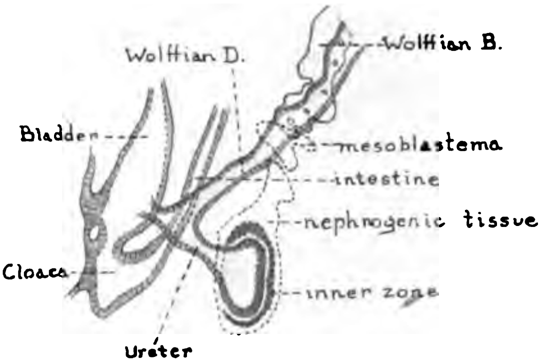

Fig. 260.—Human embryo, fifth week. (Redrawn from Schreiner: 1902.)

The first intimation of the kidney appears in the human embryo of from 6 to 7 mm. in length, as a pocket or bud formed in the dorsal portion of the lower end of the Wolffian duct (Fig. 257). Even before the appearance of this bud there is more or less distinctly outlined an ovoidal group of cells (the renal blastema or nephrogenic tissue) of the indifferent mesothelium, the lower end of which surrounds the bud and the upper end of which projects cranially toward or behind the Wolffian body. This group of cells is initially many times the size of the renal bud. Its inner portion consists of a zone of cells surrounding the bud, but separated from it by an interspace (Fig. 258). As the bud develops these cells early assume a columnar arrangement (Fig. 259). As the primitive kidney bud develops, it branches and forms hollow finger-like processes (Fig. 260). At the same time the cells of the inner zone of the renal blastema form into pockets or short tubules, which later become connected with the tubular ends of the branches of the epithelium derived from the Wolffian duct. Thus the pelvis of the kidney and its divisions with the inner portions of the straight tubules are all that is derived directly from the

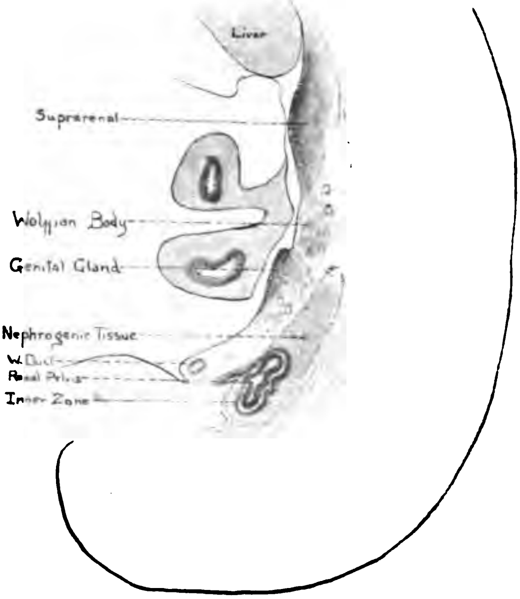

Fig. 261.—Human embryo, 11 millimeters. (Reconstructed from Mall 353, slides nine and ten.)

epithelium of the Wolffian duct; the convoluted tubules, the glomeruli, etc., all being formed from the renal blastema or nephrogenic tissue. This conception of the development of the kidney was first proposed by Kupffer,[11] receiving more or less support later by Balfour,[12] Wiederscheim,[13] Ribbert,[14] Schreiner,[15] Keibel,[16] and others, though to G. Carl Huber[17] belongs the credit of the most convincing demonstration of the details of the process.

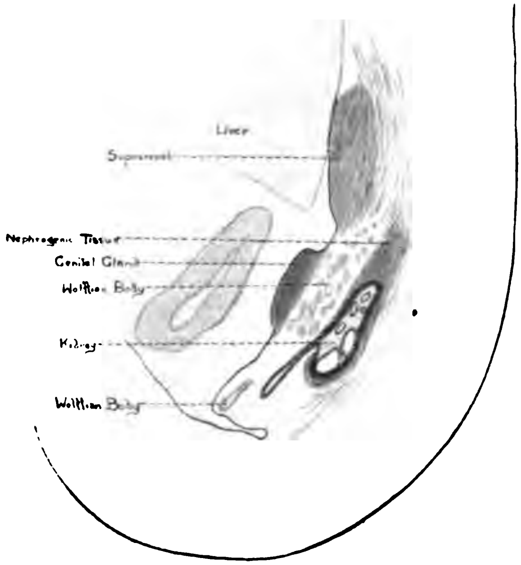

Fig. 262.—Human embryo. 12 millimeters. (Reconstructed from Minot $\begin{Bmatrix}816\\304\end{Bmatrix}$, Sections 220 *et seq.*)

The suprarenal begins its development in the 8-mm. (see Fig. 259) human embryo, as a proliferation of the ventral surface of the mesothelium at the pleuroperitoneal opening. At this stage of its development it is more than 20 per cent. of the length of the embryo between the cranial portion of the renal blastema and the caudal portion of the adrenal anlage, while interposed obliquely between the two anlagen is the whole of the Wolffian body, by far the largest mass of tissue within the embryo at this period of its development. As the kidney develops the ureter lengthens and the gland grows cranially up behind (dorsad) the Wolffian body (Fig. 261). At the same time the adrenal rapidly increases in size and develops caudally, but ventrally to the Wolffian body (Fig. 262). The kidney and the adrenal come into final apposition only by the gradual atrophy of the Wolffian, and between the two organs there is always interposed the mass of fibrous tissue which represents the stroma of the atrophic Wolffian body (Fig. 263). Long before the two organs come in any close anatomic relationship with each other, each has formed a distinct and well-marked capsule, which is greatly augmented between the surfaces of the two organs, which are directed toward each other by this dense mass of Wolffian-

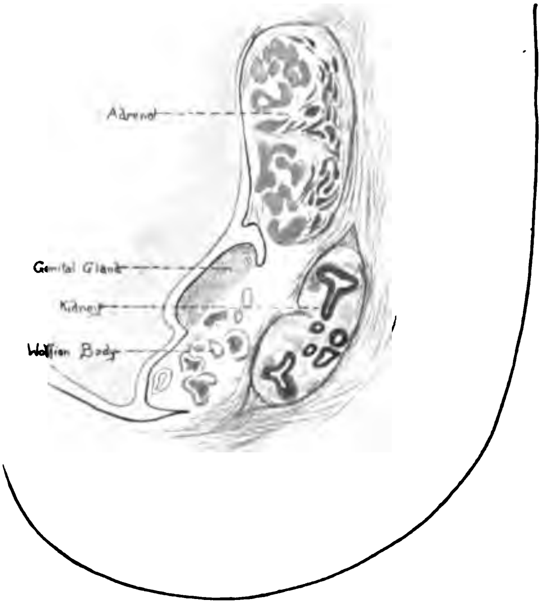

Fig. 263.—Human embryo, 13 millimeters. (Mall 406, -10-5.)

derived fibrous tissue (Fig. 264). Indeed it is difficult to conceive how any portion of the adrenal cortex can, during the process of embryologic development, become embedded within the kidney parenchyma without showing between its structure and that of the renal cortex, three distinct laminæ of fibrous tissue—the first derived from its own cortex, the second from the remains of the Wolffian body, and the third from the kidney capsule. The only tissue resembling any portion of the adrenal structure, which at any time is not well separated from the renal cortex by these three fibrous structures, consists of islets of the "chromaffin" (phæochrome) cells similar to those which constitute the medulla of the adrenal, but which, so far as I am aware, no one has found within the adrenal cortex.

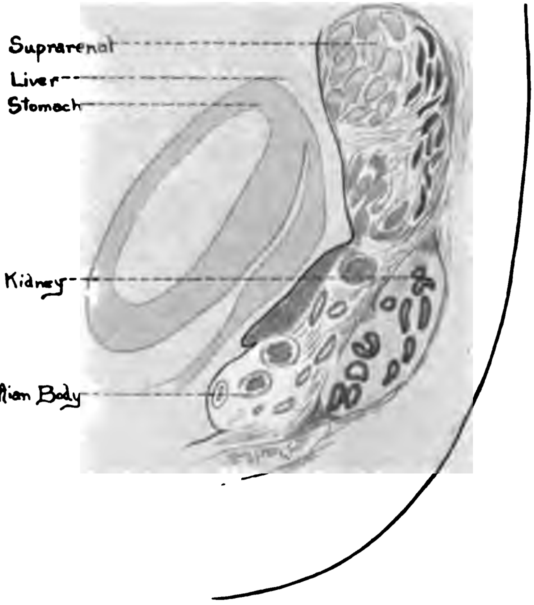

Fig. 264. -Human embryo, 14 millimeters. (Mall 144, -6-6.)

On the other hand, as the suprarenal develops, its cortex is in immediate apposition to the liver, though separated from it by two fibrous structures, its own and the hepatic capsule. Further, as has been noted, the renal blastema (nephridial tissue), while usually passing behind the Wolffian blastema (mesonephrogenic tissue) and not connected therewith, is occasionally connected with the mesonephrogenic blastema either directly or through union with a constant pyramidal-shaped islet of mesothelium (see Fig. 258), the "zwischen" or "meso-blastema," which represents a nephridial structure present in lower animal forms between the Wolffian body (mesonephros) and the kidney (metanephros).[18] It is worthy of remark that in human embryos of 10 to 15 mm. the permanent kidney (metanephros) many times shows in immediate apposition to it groups of cells from the degenerating Wolffian body with no visible fibrous connective tissue interposed. We have thus an organ, the kidney, of recent development which is rapidly growing and in immediate juxtaposition to an organ, the Wolffian body, which is degenerating. This furnishes ideal conditions for the inclusion of portions of the latter within the former. In contradistinction to this should be noted the relative development of the kidney and adrenal. The latter develops last. If it were possible for one of the organs to include portions of the other, theoretically portions of the kidney cortex should be found included within the adrenal rather than the converse, since the adrenal is the younger and more rapidly growing organ. This, however, has never been reported by any observer, so far as I am aware.

In embryos of 20 to 70 mm. there may be observed frequently at either pole of the developing kidney a more or less conical cap of nephrogenic tissue, which still preserves its finely granular mesothelial type of cell, and is in marked contrast to the other tissue of the kidney. These caps are included within the heavier permanent capsule of the kidney, though between their bases and the renal cortex may be seen occasionally a few threads of fibrous tissue. In examining single sections one is at first inclined to interpret them as the thinned-out portions of the capsule, which has been cut through lateral to the median line of the kidney, but a careful study of sections in series will prove that this is not true, but that the cap is a mass of unchanged nephrogenic mesothelium. Occasionally one is also able to demonstrate along the dorsum of the kidney, particularly opposite the hilus, a mass of similarly undifferentiated nephrogenic mesothelium. Here, however, the mass simply runs between the divisions of the calyces. These are the embryologic prototypes of the columns of Bertin. The more usual location of these masses of nephrogenic tissue is worthy of note. The ultimate fate of the nephrogenic tissue is by no means determined.

Discussion of Hypotheses

Let us now consider Grawitz's hypothesis in the light of the facts at hand:

1. From what has been stated above, suprarenal inclusion within the kidney parenchyma must be exceedingly rare, if ever present. The only instances of conjugation of suprarenal and kidney tissue which I have ever seen were masses of suprarenal tissue which were attached to the kidney, projecting above its surface, and separated from the kidney parenchyma by a thick capsule, which not only stripped readily from the kidney, but was also separable into a number of laminæ. Such a capsular structure does not exist in any of the tumors of our series, separating the tumor from the kidney parenchyma, with possibly one exception. In every other instance the dividing capsule shows evidence within it of having been formed largely by pressure of the tumor on the kidney substance. The remains of kidney tubules are found within it, and there is abundance of inflammatory overgrowth.

2. Almost a third of all "hypernephromata" arise from the lower pole of the kidney, a point at which so-called adrenal rests have not been demonstrated, and with which it is almost impossible to conceive of suprarenal tissue coming in contact.

3. The so-called adrenal rests, though reported numerous in other organs, as, for example, in the liver (in which one can readily understand their presence), are not known to form tumors either

clinically or pathologically resembling in any manner the Grawitzian tumors of the kidney.

4. Histologically, neither the normal adrenal nor any of its tumors ever show tubule or papillæ formation, one or both of which occur in probably every Grawitzian tumor. Our observations on this point fully confirm those of Stoerk and Sudeck.

5. True cordon formation occurs in kidneys unaffected by tumor formation, both in the early grouping of the inner zone cells of the nephrogenic tissue in the embryo and in the regenerating adult kidney.

6. The character of the cells in most of the tissue of the Grawitzian tumors is, as Stoerk has shown, quite analogous to structures in regenerating kidney tubules.

7. Fat and glycogen, which are present in Grawitzian tumor cells, may also be present in regenerating renal epithelium.

8. There are occasionally found, within tumors of otherwise typical Grawitzian form, areas of epithelium which is indistinguishable in its form and staining reaction from the epithelium of typical renal carcinoma. No such structure has been found in tumors of the adrenal, and it is difficult to conceive of adrenal tissue assuming such form.

On the other hand, let us consider the objections to Stoerk's hypothesis that the Grawitzian tumors are renal carcinomata developed after atrophic nephritis.

1. The Grawitzian tumors do have a predilection zone. No such zone exists in atrophic nephritis.

2. Grawitzian tumors are usually located immediately underneath the kidney capsule, with no evidence of renal cortex remains on their outer surface. The most frequent and most marked changes in atrophic nephritis are not in the outer layers of the cortex.

3. "Hypernephromata" are usually single in origin. Many tubules in widely separated areas are affected in atrophic nephritis, and consequently tubule proliferation is in multiple and widely distributed foci.

4. Grawitzian tumors frequently arise in young, otherwise

healthy individuals, who have exhibited absolutely no indication of previous renal inflammation.

5. Grawitzian tumors show early tendency to rapid degeneration. Regenerating epithelium in vascular organs, like the kidney, does not readily degenerate, and even when it does degenerate there is apt to be no clear line of demarcation between it and the surrounding living tissues.

6. Grawitzian tumors occasionally, though rarely, exhibit an epithelium which resembles in form or staining reaction that which constitutes the bulk of carcinomata of the renal calyces and tubules. If the tubules arise from convoluted tubules whose epithelium, though quite different from that of the collecting tubules, is yet in more or less direct connection with the pelvic epithelium, one would expect the tumor to spread by epithelial contiguity, and involve the epithelium of the renal medulla, thus frequently producing recognizable carcinoma pictures.

7. The presence of round- and spindle-celled sarcoma areas within Grawitzian tumors is a very common occurrence, and these areas are frequently not sharply outlined, as in the case figured by Stoerk. On the other hand, they are apt to be diffusely scattered through the tumor. Their presence and distribution seem incompatible with an origin from functioning tubular epithelium. Likewise Trotter's hypothesis of their origin from vessels is incompatible with the fact that they are neither of endotheliomatous nor peritheliomatous type.

8. Grawitzian tumors almost invariably form their metastases by way of the vessels in true sarcoma type. Carcinomata of the kidney form their metastases by way of the lymphatics.

If, then, there are so many more or less valid objections to both Grawitz's and Stoerk's hypotheses of the origin of these tumors, what explanation offers itself? Are they of Wolffian origin? The very frequent inclusion of remains of the Wolffian body within or under the kidney capsule would lead one to expect the much more frequent development of tumors from this source than from the suprarenal. But unfortunately for this hypothesis the Grawitzian tumors rarely show tubules of the broad, open type of the Wolffian body, except where they have been distended by retained secretion and their lining epithelium flattened and partially destroyed. True, the papilliferous cysts, not infrequently met with, suggest their origin from structures similar to Wolffian glomeruli, but close examination of these cysts always provides a simpler explanation. The rarity with which recognizable Wolffian inclusions ever produce even adenomata is perhaps explicable by the fact that at the time such inclusions find their way within the kidney parenchyma their epithelium is already markedly degenerated.

WORKING HYPOTHESIS

On my observations on the tumors and embryos which I have studied I venture to extend materially Adami's suggestion (see page 421) that these tumors are of mesothelial origin, and advance the working hypothesis that they are the result of proliferation of islets of the renal blastema (nephrogenic tissue) which have persisted in the cortex of the adult kidney and are excited to begin anew their embryonic activity. Such an excitation may be furnished by microörganisms, by nephritis, by traumatism (many cases give a history of related injury), or by wandering agents from the unknown world of "perverted metabolism." All the arguments based on histologic evidence which Stoerk advances in favor of the origin of the tumors from regenerating tubules apply with equal force to the hypothesis of their origin from nephrogenic remains. The isolation of such nephrogenic rests from the functionating renal epithelium accounts for the initial isolation of the tumors. The primitive embryonic type of the renal blastema may account for the embryonic type of cells in tumors resulting therefrom, and suggests an explanation of their marked malignancy. Better than on any other hypothesis hitherto advanced is their sarcomatous character, both histologically and in their mode of dispersion, explained by considering these tumors of embryonic mesothelial origin.

But if the Grawitzian tumors be derived from quiescent renal blastema wherein do they differ embryogenetically from the mixed embryonic tumors of Wilms? The characteristic skeletal content-muscle, cartilage, etc., of the Wilms' tumors is explicable only on the hypothesis of their derivation from cell inclusions from the sclerotome, a portion of the mesothelium which is well differentiated from the primitive nephrogenic tissue.

MATERIAL STUDIED

1. Fifty-four renal tumors, forty-eight of which were so-called "hypernephromata."
2. Twenty-six swine embryos (serial sections), 5 to 20 mm. (University of Minnesota).
3. Forty-three human embryos (serial sections), 6 to 70 mm. (Universities of Michigan, Harvard, and Johns Hopkins).

CONCLUSIONS

1. Most if not all so-called "adrenal rests" are probably of Wolffian origin.
2. There is almost no evidence, embryologic or histologic, in support of Grawitz's hypothesis that the so-called "hypernephromata" have their origin in adrenal rests.
3. There is much evidence that the so-called "hypernephromata" do not arise (according to Stoerk's hypothesis) from proliferations of the adult secreting epithelium of the convoluted tubules.
4. There is much evidence that the so-called "hypernephromata" do arise from islands of nephrogenic tissue (primitive renal blastema). Such tissue is sometimes present in the adult kidney and appears capable of forming tumors of the non-infiltrating, mixed-cordon, tubular, papilliform, and sarcoma type so characteristic of the so-called "hypernephromata."

I am aware that hypotheses are easily formulated and with difficulty established, and shall therefore welcome any observations which tend to either prove or disprove the foregoing working hypothesis.

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THE PREPARATION OF PATIENTS FOR PROSTATECTOMY*

By EDWARD STARR JUDD

Within the past few years the general tendency regarding the preparation of patients for surgical interference is to reduce the details to a minimum, as it has been demonstrated that patients will do much better if they are permitted to live in their own routine way up to the day before operation. Generally speaking, this rule has been most satisfactory with patients treated in our clinic, although there are some classes of cases that will do better if they are specially prepared.

In reviewing the autopsy findings in cases from our clinic that had terminated fatally following operation for the removal of the prostate, we found that the cause of death in practically every instance was kidney insufficiency, an acute nephritis superimposing upon an old kidney lesion, usually chronic nephritis. It was a little surprising at first to find that the difficulty did not occur in the cases with considerable cystitis where a catheter had been used constantly, but that it occurred in the cases with comparatively clean bladders where a catheter had never been used.

While we must bear in mind that we are dealing with cases which, because of the systemic conditions, *i. e.*, marked arteriosclerosis, etc., are not good subjects for any operation, and that we are also confronted with the fact that frequently the poorest subject, with the hard pipe-stem arteries, will endure a difficult prostatectomy with considerable loss of blood and be in good condition in a few days. On the other hand, a man in apparently good health will have an easy operation and yet gradually weaken and die in from ten days to two weeks.

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* Read before the Western Surgical and Gynecological Association, Dec. 20 and 21, 1909. (Reprinted from "Transactions of the Western Surgical and Gynecological Association," 1909.)

With beginning enlargement of the prostate there is not only the difficulty in starting the stream, but the inability to empty the bladder completely. This means that unless a catheter is used there is always some urine in the bladder. As the gland increases in size the amount of residual urine increases until at times the back pressure, coming gradually, becomes a constant factor in the function of the kidney, the urine from the kidney not being allowed to pass freely. Suppose we relieve this pressure suddenly by removing the prostate; at the same time we withdraw all the pressure from the pelvis of the kidneys, because the urine is passed unobstructed, which means that the sudden and continued withdrawal of pressure will throw the kidneys into an acute congestion, and if they are already partially disabled, the sudden change may prove very serious, resulting in acute nephritis and suppression. This point applies to all cases with a considerable amount of residual urine, but especially to the case where a catheter has not been used. To overcome this difficulty we commence by emptying the bladder with a catheter at stated intervals, twice a day at first, gradually shortening the intervals until the bladder is emptied every hour. In some instances we have left the catheter in the bladder for several days, although this is dangerous at times, and in our experience it has never been satisfactory. We frequently spend from two to three weeks in gradually withdrawing the residual urine.

Occasionally the passing of the catheter is followed by a chill and a general disturbed condition caused by the irritation to the urethra. This symptom decreases each time and is not a serious complication. Becoming accustomed to this irritation, the reaction following the trauma to the urethra is lessened at the time of operation. It has been our experience that these cases do much better if they have been frequently catheterized for some time previous to the operation.

There is no particular advantage to be derived from special diets. It is important that the digestive tract should be as little disturbed as possible, therefore the regular diet is maintained up to the morning of the operation.

One ounce of castor oil given forty-eight hours before operation is most satisfactory, as the patient will be over the effect of the physic beforehand. Salt solution per rectum soon after operation is helpful in many cases to increase the elimination through the kidneys. Any tendency toward looseness of the bowels is therefore most undesirable.

We frequently find that these cases have been drinking very small quantities of fluids, in order to diminish the amount to be eliminated, as a great deal of suffering is caused when the urine is voided. The arteries of these patients are hard and inelastic, and if we allow this condition to prevail it will be difficult to fill up the circulation, and we therefore encourage the patient to take great quantities of fluids for several days, which fills the circulation and throws the kidneys into marked activity.

Urotropin, given in 7- to 10-grain doses several times each day for several days previous to operation, will also help the condition and tend to improve the quality of the urine.

The local preparation consists in washing the bladder with boric acid solution each time the catheter is used. The urine is all withdrawn shortly before the operation and the bladder left empty.

The skin is scrubbed with soap and water and shaved an hour before the patient is sent to the operating-room. At this time the area is thoroughly cleansed with soap and water again, then sponged off with Harrington's solution for thirty seconds, and this is washed off with 80 per cent. alcohol.

Several twenty-four-hour specimens should be obtained. The amount voided in twenty-four hours and the quality as regards urea, determined by the specific gravity, are the most important factors. Albumin is usually present because of pus from the cystitis. The presence of hyaline or granular casts is not a contra-indication to operation, if the specific gravity is high. Blood in greater or less amounts is invariably present, but usually is not of much significance, especially if other conditions are favorable. If the total twenty-four-hour elimination is small, say 400 to

600 c.c., the specific gravity under 1010, and hyaline and granular casts are present, we accept considerable risk in operating; but after several days of forcing the amount of fluids and withdrawing all the residual urine from the bladder, we are often able to double or treble the amount eliminated in twenty-four hours, and the specific gravity will be several degrees higher. The patient will then be in a much better condition for operation.

The cystoscope is very valuable in helping to determine the amount and kind of preparatory treatment these cases should have, and it is also an aid in deciding the type of operation to be performed. Some surgeons do not believe it is wise to cystoscope these cases, fearing to cause complete retention. We have not encountered this complication. While the cystoscope cannot be used satisfactorily in all cases, the information obtained in the majority of instances will be most valuable.

During the past year we have performed 82 prostatectomies, and in 67 of these cases we were able to do a thorough cystoscopic examination. In no instance was the examination especially severe; nor did it cause acute retention. The cystoscope clears up any point that may arise in differential diagnosis, *i. e.*, diverticulitis, neoplasms, stones, etc. At times the ureteral orifices can be seen, and we get an idea of the quality of urine as it comes from the kidney. Cloudy urine shows that pus is coming from one or both kidneys, and not altogether from the bladder. We can also tell the condition of the mucous membrane of the bladder, the number and size of the calculi, if they are present, the size and position of the median lobe, and as to whether it will be easier to remove the prostate through a perineal or suprapubic incision.

An operation should not be attempted during an acute cystitis or epididymitis. Chronic cystitis is almost always present to some degree in all cases. If marked, it should be treated for several days by frequent irrigations.

We do not believe it is ever advisable to remove the gland in the stage of acute retention. In 11 of our 82 cases there was acute retention, and we were unable to pass a catheter into the bladder. We cocainized the skin just above the pubic bone over the distended bladder and pushed a large trocar into it; then withdrawing the obturator we passed a retention-catheter through the cannula into the bladder. The cannula was then removed, and the catheter left as a drain until the patient was in a condition to undergo the operation, which will usually be from two to six weeks.

During the past year 82 prostatectomies have been performed in the clinic at St. Mary's Hospital. The perineal route has been employed by preference, 52 of the 82 cases having been done in that way. Either because of a high-lying gland that we were unable to reach over by rectal examination, or because of a large stone in the bladder, or a large intravesical median lobe, the suprapubic operation was done in 30 of the cases.

The oldest patient in this series was a man eighty-four years of age, with carcinoma. The youngest was twenty-nine years of age, with a tuberculous prostate. Seventeen of the patients were over seventy years. Sixty-six were over sixty years, and five were under fifty years of age. Fifty-five of the 82 patients used a catheter, some of them constantly, others occasionally. In 11 instances suprapubic stab-drain for acute retention was performed preliminary to prostatectomy.

Pathologic examination revealed that the enlargement in the gland in 73 of the cases was due to a fibroadenomatous hypertrophy. There were 6 cases of carcinoma, 1 of tuberculosis, and 2 were inflammatory. Stones were present in the bladder in 8 of the cases.

Four cases in the series of 82 were fatal.

Case 1.—Patient aged fifty-four years; urine 1.001; trace of albumin. Had trouble but a few weeks, during which time he lost 30 pounds. Acute retention relieved by catheter.

Suprapubic prostatectomy was comparatively easy, and was done in a few minutes—fibroadenomatous hypertrophy. The second-day pulse ranged from 100 to 120 and very high tension. He voided a few ounces of urine, amount gradually diminished; became drowsy; pulse full; uremic in forty-eight hours; died on the fifth day.

Autopsy.—Left kidney small, almost no functionating tissue, filled with pus. Right kidney large, about one-fifth functionating, and showing acute nephritis, also filled with pus. No other findings at autopsy.

Case 2.—Patient aged sixty-eight years; urine 1.010; 1625 c.c.; hyaline and granular casts. Patient much run down in general way; ten years trouble; never had used catheter.

Perineal prostatectomy; large lateral lobes; fibroadenomatous hypertrophy. Patient did well for one week, was up and voiding one-half of urine through urethra. Sudden chill; good quantity of urine, but of low specific gravity and casts; chills became frequent, and the patient died at the end of three weeks.

Autopsy.—Small, hard kidneys filled with small abscesses and acute nephritis; much scar-tissue, and evidence of old abscesses. Findings otherwise negative.

Case 3.—Patient aged sixty-one years; urine 1.003; 1300 c.c.; trace of pus. Seven years trouble; had used catheter a few times; suffered intensely from acute cystitis and infection in prostate. Perineal prostatotomy and partial prostatectomy done for drainage of infection in gland and bladder. Temperature had been 102° to 103° for several weeks before operation. Infection apparently subsided and temperature was normal for one week, when it became subnormal, and the patient became uremic and died on the fifteenth day.

Autopsy.—Very large, foul bladder; marked acute nephritis in both kidneys.

Case 4.—Patient aged seventy-four years; ten years trouble. Acute retention on several occasions; used catheter.

Perineal prostatectomy; large bilateral enlargement; fibroadenoma. Died on the eighth day of uremia from acute or chronic nephritis.

While it is not reasonable to suppose that we shall ever be able to operate upon these cases without any mortality, at the same time I believe that if we pay more attention to the function of the kidneys before operation, raising this to the highest point possible, we shall reduce the mortality to a very small percentage.

DUCTLESS GLANDS

DIAGNOSIS OF HYPERTHYROIDISM OR EXOPHTHALMIC GOITER*

BY CHARLES H. MAYO

The ancient history of hyperthyroidism or exophthalmic goiter amounts to a rather imperfect description of the disease by several observers of a few cases each. The condition was formerly considered as purely medical, and the knowledge of existing conditions was derived solely from autopsies which necessarily presented many changes in structure throughout the body which were not present in the early stages of the disease. In fact the condition of the thyroids did not appear to call for any unusual attention as compared to other organs because macroscopically they often resembled enlarged thyroids of the simple type.

For the past fifty years clinicians, who have based their knowledge upon symptoms and upon terminal changes as found at autopsies, have endeavored to classify certain cases of goiter within the narrow limits of the description of the few cases reported by those remarkable men, Parry, Graves, Basedow, and others nearly a century ago.

To-day even with the great progress in medical science we are lacking very much in our knowledge of the subject. Formerly only such cases as presented all the symptoms in a severe form were accepted as Graves' disease. The belief that the disease represents a condition *sui generis*, and thereby differs from nearly all other diseases, still prevails among many members of the medical profession. They pronounce well-marked cases as *fruste* or *pseudo* until the eyes become prominent. Should this feature be delayed, even if all other symptoms are present, it is not until this condition appears that the disease is properly labeled; after all, representing but a syndrome of symptoms (Figs. 265, 266, and 270).

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* Reprinted from "Surg., Gyn. and Obstet.," August, 1910, pp. 129-132.

It is now definitely shown that the condition is not one which involves all the organs at the onset, but that it is like other diseases in presenting acute, chronic, mild, severe, and irregular or remittent types.

In the development of the surgery of simple goiter during the last thirty years many patients have been operated upon who had either at the time of operation or previously many, if not all, of the symptoms of exophthalmic goiter. If symptoms of hyperthyroidism were the main indications for operation, the cases were classified accordingly, otherwise they were considered as simple or encapsulated goiter with partial or temporary hyperthyroidism.

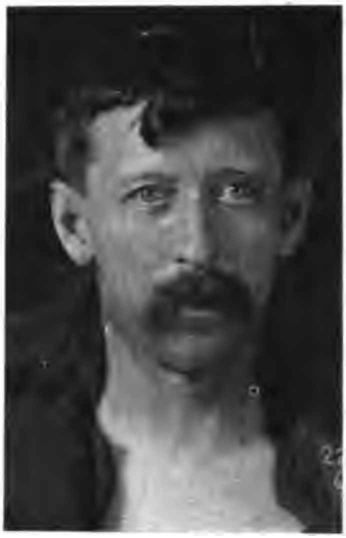

Fig. 265.—Hyperthyroidism with little glandular enlargement and no exophthalmos.

Results of the accumulated knowledge in the examination of all forms of thyroid disease the world over, is that there is a definite increase in the parenchyma of the gland in all forms of exophthalmic goiter, with evidence of over-activity of cell secretion. This evidence may present itself in several ways: (*a*) increase of cells in the alveoli, (*b*) increase in the number of alveoli, (*c*) by papillomatous invagination into the vesicles of the gland. All of these changes may be throughout the gland or only in areas of it. Pathologists who are experienced in this class of laboratory work are usually able to give the symptoms and stage of the disease from a typical microscopic slide, and from the form of the degeneration of the tissues in some cases can estimate the probable condition of the heart, liver, and essential organs.

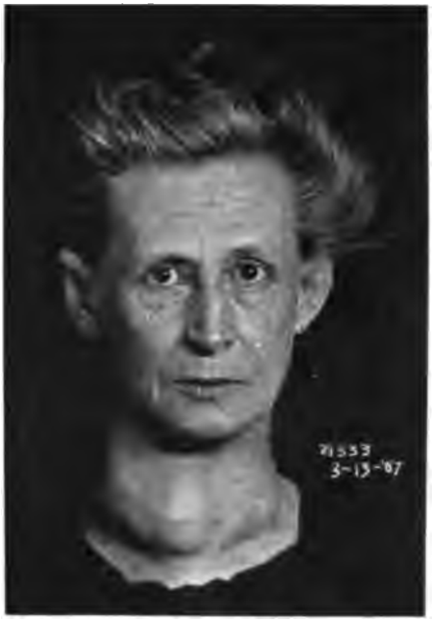

Fig. 266.—Hyperthyroidism with thyroid enlargement but no exophthalmos.

It seems probable that a thyroid which presents this condition of hyperthyroidism and does not destroy the life of the individual or destroy itself must at some period of its activity revert back to simple goiter. Then colloid will be deposited with iodothyroglobin and the gland will lose its apparent cell activity.

From the examination of a great many thyroids of this type it would seem that this change or reversion may appear at any period, and that certain exceptional individuals are able to withstand the disease until there is a degeneration of the parenchyma and positive loss of secretion or hypothyroidism, shown by varying degrees of myxedema as a terminal condition following former hyperthyroidism. There may be wide variations in the quantity of thyroid secreted in simple and cystic goiters within the limits of health. Theoretically in the one case there should be hypothyroidism, in another hyperthyroidism, yet neither of these conditions can be constantly recognized. The break in the equilibrium of the associated ductless glands to produce hyperthyroidism under such conditions is seemingly brought about in the majority of cases by some infectious disease or severe illness, although a considerable number of cases exhibit the first symptoms through a change in the nervous system following a severe mental shock.

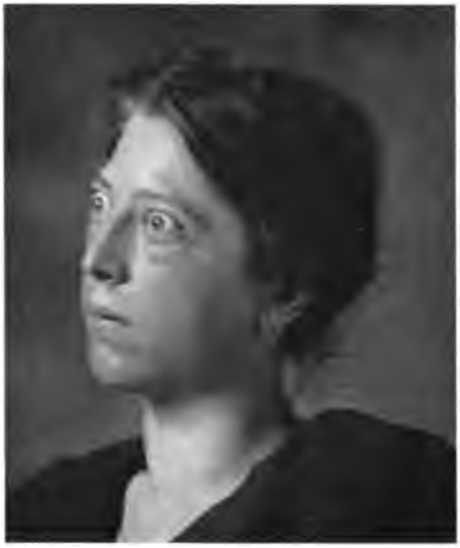

Fig. 267.—Hyperthyroidism with little glandular enlargement but marked exophthalmos.

In fact there has been but little added recently to our knowledge of the etiology of simple goiter, and concerning that of exophthalmic goiter much is written and little is known. Heredity appears to be an important factor in some cases. We still lack the knowledge as to whether the stimulus is from within or without as a chemical irritant or hormone. The gland elaborates iodin, of which there is less in the gland of hyperthyroidism than in the normal gland, but Reid Hunt has shown that in such cases there is more iodin in the blood, it being produced, delivered, and slowly excreted from the system contrary to its usual rapid elimination. It is also shown by Marine and others that colloid goiter contains more iodin in the whole gland than in the normal thyroid, but bulk for bulk the colloid goiter contains less iodin than normal thyroid. It is possible that colloid is capable of holding the secretion of the

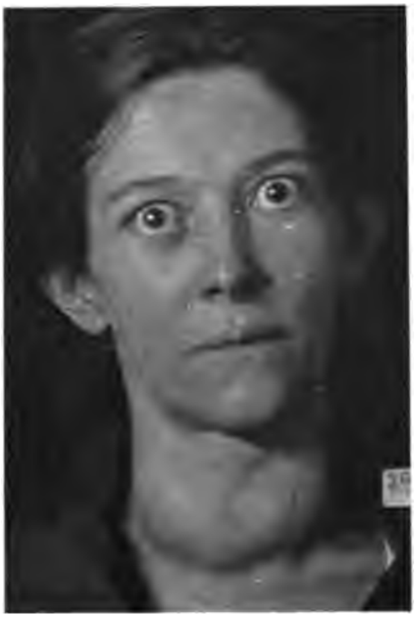

Fig. 268.—Hyperthyroidism with both thyroid enlargement and exophthalmos marked.

gland without suffering destruction, and in the retention of the secretion with colloid, the size of the thyroid is necessarily increased. Marine believes that hyperthyroidism is induced by a lack of some essential secretion of the thyroid considered as a complex substance, and in the effort to restore this, an excess of some component part of the secretion is produced to a toxic degree.

Reviewing briefly the most important manifestations of hyperthyroidism we have tachycardia as the most usual heart condition. In advanced cases the heart may be irregular in rhythm and the pulse of low tension. Dilatation of the heart must be differentiated from dilatation with hypertrophy and compensation, and from pure myocardial disease as well.

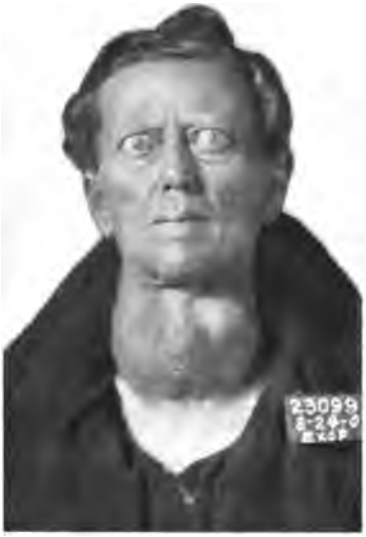

Fig. 269.—Hyperthyroidism, terminal results: Chronic toxemia not abated, but leaving myocardia and general degenerative changes.

The eye symptoms are numerous and may appear early or late, and one or all of them may be present. These symptoms consist of: · prominence, a widening of the palpebral fissure (Dalrymple), staring without winking (Stellwag), lagging of the lids with eye movements (Graefe), insufficiency of accommodation at near point (Moebius). Rarely there is dislocation of the globe. Ulcer of the cornea is not uncommon in marked cases. Myocardial changes and Bright's disease may also produce some of these symptoms.

Tremor is nearly always present, eight or nine to the second, and may be associated with chorea-like movements in extreme cases with, as a rule, great muscular weakness (Figs. 267 and 268).

As to goiter: The thyroid may be but little enlarged in the early cases, or enlargement may be the first symptom. If it is present a long time previous to the onset of Graves' disease, the microscopic changes will be parenchymatous increase of cells projecting into the colloid retention in the vesicles. From these cells the secretion is derived. Operative deductions from certain cases would indicate that a wonderful cell increase may occur with but little enlargement of the thyroid as a whole, and it is apparent that the secretion is delivered and not retained (Fig. 271).

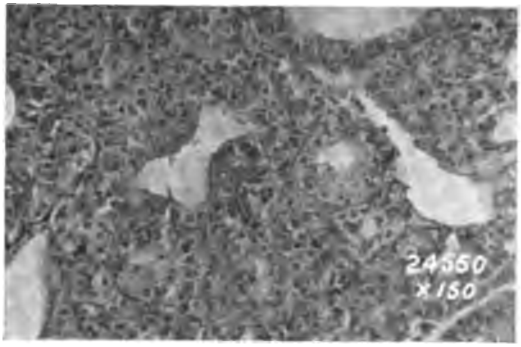

Fig. 270.—Exophthalmic goiter.

The general symptoms are sweating, anemia, emaciation, and loss of strength in the majority of cases. Vomiting and diarrhea without apparent cause are common but transient symptoms. Pigmentation of the skin is often seen and a bronzing is not unusual. Urine small in amount. Albumin is found occasionally in many cases. Patients in advanced conditions may have it in considerable amounts, as well as the hyaline and granular casts. Transient glycosuria is often noted, and occasionally a true diabetes. Irregular fluctuations of temperature tending to normal, yet often up one and two degrees, are common. There is often excitable or nervous irritability, and sometimes altered disposition with mental depression and signs of mania.

It must be remembered that malignant goiter may at times present the most aggravated picture of Basedow's disease.

In the diagnosis of hyperthyroidism, Kocher regards leukemia of the neutrophilic polymorphonuclears as an important early symptom, also a percentage and absolute increase in the lymphocytes. In over two hundred blood tests made upon patients with goiter, most of them with hyperthyroidism, we have at times found such changes marked, although some of the advanced cases varied greatly, sufficiently so to classify the condition in the same category with other laboratory tests (Fig. 269).

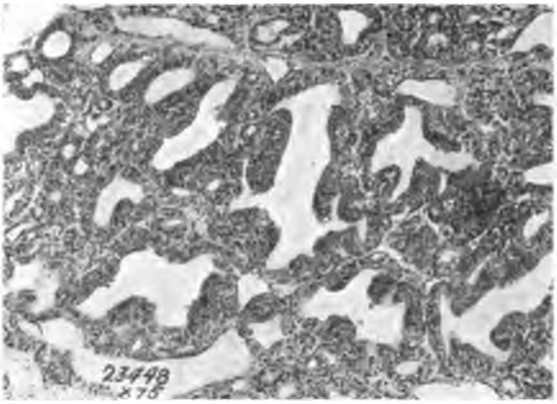

Fig. 271.—Papillomatous increase. Secondary hyperthyroidism following primary simple goiter.

Notwithstanding the fact that many patients with the disease are cured spontaneously, and many are improved or cured by some type of medical, semimedical, or a form of serum treatment by cytolysis, the condition known as hyperthyroidism has stepped boldly into the field of surgery. It must be conceded that the operation is a serious one; that operating on those suffering from hypothyroidism because they still have some signs of Basedow's disease will not benefit the patient, the surgeon, or surgery. Operations upon advanced cases of hyperthyroidism will not cure fatty degeneration of the heart muscle, nor fatty degeneration of the liver, nor advanced changes in other organs, although the disease may be checked by reducing the toxemia. Altogether too much is expected by those personally interested, especially from operations made under such conditions. The responsibility of the operator being great, the diagnosis of the condition, the accurate estimate

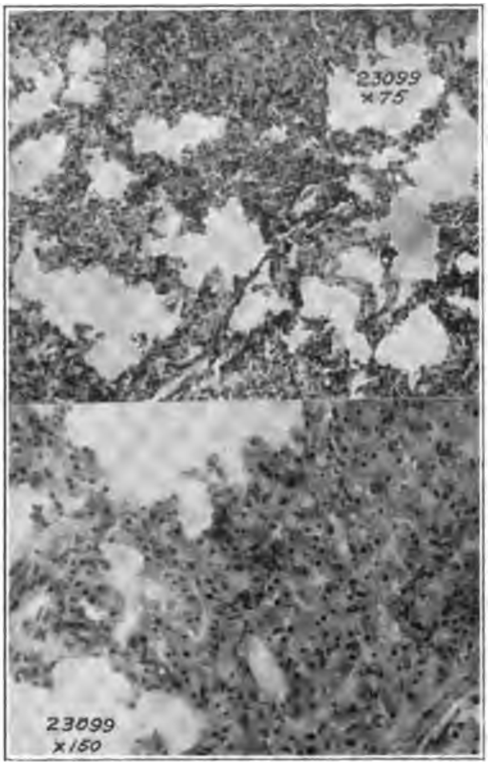

Fig. 272.—Late degeneration in hyperthyroidism.

of the stages of the disease, and the approximate condition of the gland and essential organs, must now be weighed with much more care than when the condition was considered purely medical and a death from it the "will of God."

The physician's judgment in his estimate of the patient's condition may lead him to advise first some form of non-surgical treatment, *e. g.*, therapeutic, hygienic, etc. If improvement does not soon follow these measures, a surgeon should be called in consultation, who may, from his standpoint, advise immediate operation or a continuation of, or additional treatment in the preparation of the patient for operation either upon the blood-supply of the gland or upon the gland itself at a later period (Fig. 272).

OBSERVATIONS ON THE VOCAL CORDS IN ONE THOUSAND CASES OF GOITER*

By JUSTUS MATTHEWS

My report is made on the observations of the vocal cords in 1,000 cases of goiter examined during the past two years. About 95 per cent. of the patients were operated on; all were examined before operation and re-examined after operation.

The anatomy of the larynx may be passed over, with the exception of the motor nerve-supply of its intrinsic muscles, which will be considered only with reference to liability to paralysis from pressure by enlargement of the thyroid gland.

The cricothyroid muscles, which are the tensors of the vocal cords, are supplied by the external branches of the superior laryngeal nerves from the pneumogastrics. These branches enter the muscles so high that only the largest lobes, which extend unusually high on the throat, can exert pressure on them. All the other muscles, including abductors, adductors, and decreasors of tension, are supplied by the recurrent laryngeal nerves, which also arise from the pneumogastrics. These opposing muscles are supplied by different fibers which merely travel in the same nerve-trunk, either set of which, or all together, in any degree may be subject to paralysis.

In this series of cases, as well as in the observations of others, it appears that the fibers supplying the abductor impulse to the posterior crico-arytenoid muscle are the most readily affected by pressure.

The right inferior laryngeal nerve arises at the level of the right subclavian artery and, winding around that vessel, passes upward in the groove at the right side of the trachea and esophagus and enters the larynx at the edge of the cricoid. The left inferior arises at the level of the arch of the aorta, around which it passes and ascends on the left in the same manner as the right inferior nerve. The relation of the left laryngeal nerve to the aorta and its longer course account in part for the fact that it is more frequently affected by local pressure. Moreover, the position of the esophagus to the left of the median line forces the nerve to take a position more exposed to pressure, especially at the level of the thyroid gland.

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* Read in the Section on Laryngology and Otology of the American Medical Association, at the Sixty-first Annual Session, held at St. Louis, June, 1910. (Reprinted from "Jour. Am. Med. Assoc.," Sept. 3, 1910, pp. 826–827.)

Examination of Cases.—In the examination of 1,000 cases there were found 17 with paretic affections of both cords, 93 of the right cord, and 162 of the left, making a total of 289 partial or complete paralyses in 272 individuals. Total paralysis of the right cord occurred 18 times; of the left, 30 times. Partial or complete abductor paralysis of the right occurred 50 times; of the left, 83 times. Partial loss of both motions of the right occurred 38 times; of the left, 62 times. Bilateral tensor paralysis occurred in 4 cases.

In classifying the cases as to the size of the right, median, and left lobes, a division was made for each ½ inch in diameter. It was found that paretic conditions of the right cord increased from 5.3 per cent. in 226 cases with small or non-palpable right lobes to 25 per cent. in 8 cases with lobes over 5 inches in diameter. Abductor paralysis and partial paralysis of both movements increased more rapidly in goiters ranging up to 3½ inches in diameter, and then gave place to a relatively greater increase of total paralysis. The left cord showed 10 per cent. of paresis in the goiters with small left lobes, increasing to 47 per cent. with those over 5 inches in diameter. There was a still more marked tendency for all affected cords to become totally paralyzed as the lobes became larger. This occurred in 5 of 15 cases. Even great enlargement of the median lobe alone was seldom associated with affections of the cords. Total paralysis occurred in but 2 such cases, bilateral tensor paralysis in 4, and minor affections in 9. In nearly every

TABLE OF OBSERVATIONS IN CASES OF GOITER

30

		Paralysis.		Paresis.	Abductor.	Tensor.
Number of cases	1,000					
Cords affected (Right, 110; Left, 179)	289					
One or both cords affected	262	Right	18	38	50	4
Bilateral	17	Left	30	62	83	4

Right Cord

Size in inches	0–1	1–1½	1½–2	2–2½	2½–3	3–3½	3½–4	4–5	5+
Number cases	226	159	152	141	138	85	70	21	8
Cords affected	12	13	14	14	17	18	15	5	2
Number per cent	5.3	8.1	9.2	10.0	12.5	20.6	21.3	23.8	25.0
Paralysis	1	0	0	3	3	2	5	2	2
Number per cent	0.5	0.0	0.0	2.1	5.1	2.3	7.1	10.0	25.0
Abductor	6	7	8	5	7	9	6	2	0
Number per cent	2.7	4.4	5.2	3.5	5.1	10.3	8.5	10.2	0.0
Both motions	4	5	5	6	7	6	4	1	0
Number per cent	1.8	3.2	4.4	4.2	5.1	7.1	6.7	5.0	0.0

Left Cord

Size in inches	0–1	1–1½	1½–2	2–2½	2½–3	3–3½	3½–4	4–5	5+
Number cases	259	155	183	146	104	65	52	21	15
Cords affected	28	19	27	29	26	20	15	8	7
Number per cent	10.8	12.2	14.7	20.0	25.0	30.7	28.8	38.0	46.6
Paralysis	3	1	3	4	3	2	5	4	5
Number per cent	1.1	0.6	1.6	2.7	3.0	3.1	9.6	19.0	33.3
Abductor	11	10	13	15	13	10	6	3	2
Number per cent	4.2	6.0	7.1	10.0	12.5	15.3	11.5	14.3	13.3
Both motions	13	9	10	10	9	7	4	1	0
Number per cent	5.0	5.2	6.6	6.8	8.6	11.8	7.7	5.0	0.0

division, except that of the largest lobes, abductor paralysis, either partial or complete, was the lesion most frequently seen.

Although the average frequency of symptoms of pressure on the nerves was directly proportional to the size of the lobes, there were exceptions. For example: paralysis occurred when the corresponding lobe was not palpable. On the contrary, in some cases which had the most tremendous enlargement of the lobes, displacing and distorting the larynx and the trachea, there was no apparent effect on the movements of the cords.

In a series of 100 consecutive cases in other than goiter patients, or patients coming on account of laryngeal symptoms, there were found one case of total paralysis of the left cord without noticeable symptoms, one case of partial and one of complete abductor paralysis, and two of partial loss of both motions of the left cord. In one case only, the right cord showed a deficiency of both motions. These patients were more than normally liable to affections of the cords, since most of them came for other pathologic conditions in the nose and throat. But, since goiter patients are also especially affected by diseases of the nose and throat, it might be considered proper to deduct from the percentage due to goiter the 6 per cent. found in these cases. This would, in cases of slight enlargement of the thyroid, make the percentage for the right and left cord nearly equal, while in cases of greater enlargement the left cord would still show a relatively greater tendency to paralysis from pressure, probably on account of the more exposed position of the left recurrent laryngeal nerve.

The position of the lobes is quite as important as the size of the goiter, since, for goiters of the same size, affections of the cords are much more frequent in those cases with lobes located near the clavicle, especially if all or a portion of the goiter is intrathoracic. Exceptions to this are the cases in which the large lobes extend so high as to reach the external branch of the superior laryngeal nerve. This condition occurred in 4 cases which showed bilateral tensor paralysis caused by large, high median lobes. Firmness is likewise important, since small, hard lobes are more apt to injure the nerves than larger soft lobes.

Long duration of the goiter increases liability to vocal paralysis, probably because, as a rule, the older cases have the greater enlargement. Apparently there is also an additional danger from long-continued pressure.

Men are about three times as liable as women to paralysis from goiters of the same type.

Exophthalmic goiter does not differ materially from other forms of goiter in its effects on the vocal cords, except in cases of extreme hyperthyroidism, in which its effects are evidently increased as a direct result of general wasting of muscular tissue.

The age of the patient has no demonstrable relation to the pressure on the recurrent laryngeal nerves, except that goiters of large size and long duration are more frequently found in older individuals.

Results of Operation.—In five cases the partial paralysis observed before operation had disappeared after operation, showing that the pressure must have been of short duration and not sufficient to cause permanent degeneration of the nerve. In eight cases of partial paralysis following operation, probably due to the pressure of edematous tissue in the region operated on, later observations showed complete recovery. Twenty-two cases of partial paralysis following operation were observed but once, so that the ultimate result was not ascertained. In several cases with disturbance of phonation after operation, positive diagnosis could not be made between paralysis and edema.

Twelve cases of total paralysis followed extirpation of the lobes; three of these were malignant. Two cases followed ligation of the thyroid artery. In four of these cases aphonia appeared two or three days after operation, indicating that the cause was pressure and not section of the nerves, and therefore that the prognosis was good. No patient with total paralysis, observed either before or after operation, was seen to have recovered, though, through lack of opportunity for reëxamination after the lapse of considerable time, such recovery might have escaped notice.

The frequency of paretic conditions, often without change of voice or other symptoms, emphasizes the necessity for careful laryngoscopic examination of all cases before operation. This is important, since it is essential to the prognosis of post-operative lesions, and might be especially valuable in some cases, as showing the possibility of repairing damage by suturing the nerve severed during operation. Moreover, a beginning paralysis of the laryngeal muscles, apparently due to the pressure of the goiter, would be an indication for early operation in order to prevent complete and permanent degeneration of the nerve.

INTRATHORACIC GOITER, WITH REPORT OF CASES*

BY CHARLES H. MAYO

Embryologists show that the several parts of the human thyroid gland unite at about the seventh week, the lower poles being formed from buds in the fourth branchial groove. The thymus gland originates in the third groove and descends to a lower situation. Through the changes incident to this transposition, it is possible that we have one of the causes for the malposition of a part of the thyroid to a situation within the chest, as an intrathoracic goiter, or the development of an accessory or aberrant thyroid in this position when it is completely separated from the main portion of the gland.

In the majority of instances the ordinary or simple tumors of the thyroid consist of two types: the colloid goiter, or diffuse adenoma, and the encapsulated adenoma, or fetal type, within the gland. The first form, when of an irregular and nodular character with large retention and colloid cysts, is often called follicular goiter; and the second form, cystic goiter or cystic adenoma. The greater number of intrathoracic goiters are one of these two varieties. If the tumors are of the colloid variety, they extend into the chest as a prolongation of one of the lower poles, with something of a narrowing or constriction of the gland where it passes through the reduced space behind the upper portion of the sternum. The depth of the extension within the chest, considering the growth in the nature of a true intrathoracic goiter, would probably be two or more inches below the upper sternal border. Such downward growths carry with them, as an outer covering, the loose fibrous capsule, while the true capsule of the thyroid becomes considerably thicker than normal and may become fused. The second and equally common form of substernal tumor is the encapsulated fetal adenoma, which varies in size from small tumors of an inch or more, surrounded by more or less thyroid, to tumors the size of an orange, which have destroyed surrounding thyroid by pressure, and are left with the thyroid capsule as a secondary covering, with possibly a remnant of gland in a thin layer.

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It is probable that not to exceed one-half of the intrathoracic goiters are diagnosed as a complication previous to their discovery during operation for goiter. Most patients having this form of goiter complain of pressure symptoms, described by them as being suffocative under exertion. In addition to actual tracheal compression there is usually some change in the voice, a metallic sound from some paretic condition of a vocal cord, due to pressure upon a recurrent laryngeal nerve. Mechanical or toxic irritability and irregularity of the heart are not unusual conditions. The size, appearance, and density of the thyroid in the neck, in such cases are not sufficient as physical findings to account for the severity of the symptoms, and this should lead one to suspect intrathoracic goiter.

The appearance of the gland in the neck is usually that of a moderate-sized tumor, which seems to enlarge at its base or to disappear into the chest. From some radiographs which we have taken of the condition, it would appear probable that the *x*-ray may be made a useful adjunct in diagnosing the condition more frequently before operation. Tumors of the thymus, or thymus hypertrophy, must be differentiated.

Large goiters of a colloid type may also encroach upon the sternum and extend somewhat behind it, but they are not constricted or tongue-like in their projection into the chest, like the tumors under consideration, and should not be classed as such. Whatever variety the growth proved to be, we have always found the tumor connected with but one lobe of the thyroid, although it might extend to the other side of the trachea on its anterior or posterior surface within the chest.

Embarrassment of respiration may necessitate a local anesthetic. The anesthetic usually given is ether on the open mask, and it is preceded by morphin, $\frac{1}{6}$ gr., and atropin, $\frac{1}{120}$ gr., which allays

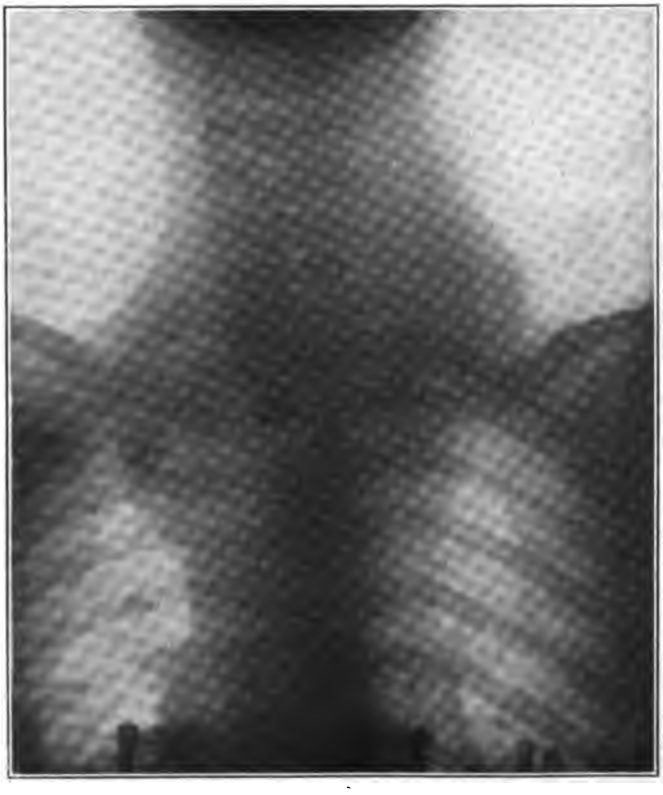

Fig. 273.—Substernal adenoma of the thyroid.

nervousness and reduces the amount of ether required. These drugs also check bronchial irritation and tracheal mucus. In spite of this there is ordinarily an unusual amount of respirative difficulty, due to pressure upon the trachea, especially if there is venous pressure, which causes a vicious circle of trouble. If anything, it may be made worse upon exposure of the gland after a transverse incision with section of the muscles, since the gland in pushing forward constricts the trachea below.

At this stage the isthmus is quickly divided and clamped, the two halves of the thyroid being forced apart to expose the trachea. Extirpation of a lobe may be attempted, or the lobes are incised and shelled out, and clamped with many forceps, first on one side and then on the other, in an effort to free the trachea. Although the breathing may still be difficult, sufficient room is now obtained to explore beneath the sternum and examine the trachea when an

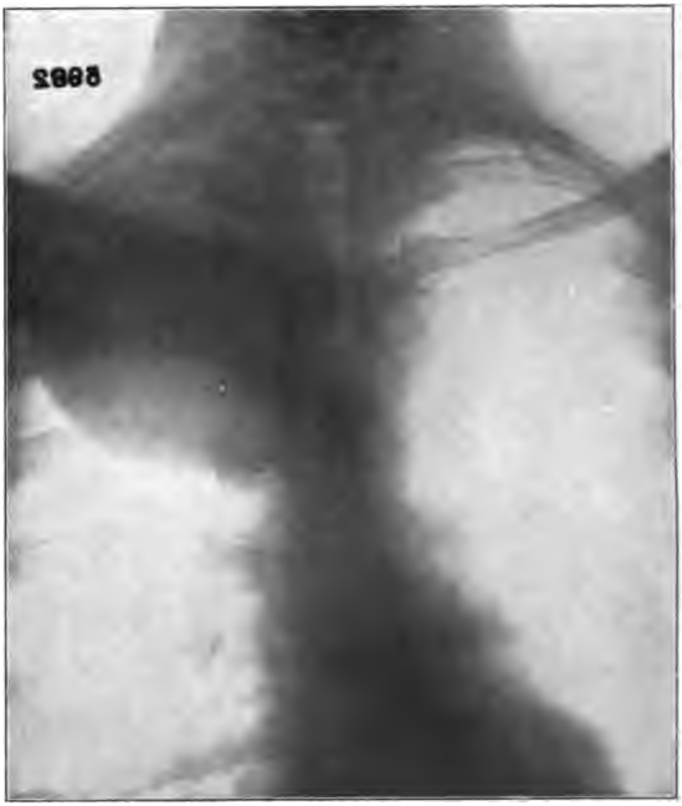

Fig. 274.—Substernal adenoma of the thyroid.

extension of the thyroid is found, either as colloid masses or the exposed end of an encapsulated adenoma. As has been shown, there is a fairly heavy capsule covering these substernal tumors, which will permit their finger-enucleation with comparative safety, although bloody. Respiration improves immediately the tumor is removed.

In our experience great hemorrhage followed delivery of the goiter in but one case. This hemorrhage was venous, and was checked immediately by packing four large abdominal sponges within the chest, which were left in place four days, then removed without trouble, and a lighter pack substituted. Secondary hemorrhages occurred fifteen and twenty-five days later, when the cavity was filled with Beck's hard paste of vaselin and bismuth, which was followed by healing in a few days.

In delivering the growth it is well to leave the base attached to the capsule, so that the capsule may be caught with many forceps as the tumor is elevated. Locking sutures of catgut may be employed to obliterate the pocket thus everted, intrathoracic pressure filling the space formerly occupied by the tumor. It has been shown that this eversion of the capsule is impossible in certain cases, and, as a part of such a space must be closed by granulations or by an organized blood-clot, drainage should not exceed twelve to twenty-four hours, because if the pocket is allowed to drain for many days, it will probably discharge for weeks until granulations obliterate the space.

If intrathoracic tumors of the encapsulated adenoma type are broken into and not removed, they are likely to discharge for an indefinite period.

Many substernal extensions of the thyroid have been removed during the operation for simple goiter, but of the type under discussion we have operated upon nine of the encapsulated adenoma, and nine of the extension of colloid goiter far down in the chest. The encapsulated adenoma type are usually the larger, weighing from 50 to 200 grams. The relief following the operation of pressure is most marked, and usually the voice is greatly improved where there is incomplete paralysis of the recurrent laryngeal nerve.

LIGATION AND PARTIAL THYROIDECTOMY FOR HYPERTHYROIDISM*

By CHARLES H. MAYO

Within the past few years a great deal has been added to our knowledge of the ductless glands, but in none of them are greater changes observed in the structure of the gland itself, or the symptoms more manifest in the individual caused by changes in secretion, than in the diseased thyroid. Data concerning the overactive thyroid have traveled up through a century and a quarter of symptomatology which varied between the heart, the nervous system, and intestinal toxins, until Moebius presented his theories of hyperthyroidism twenty-five years ago.

Lacking in a pathologic picture for so long a period, the peculiar syndrome of symptoms which marked the condition was naturally designated in its various forms by the name of the author whose views had become best known.

In the peculiar relationship in function of the ductless glands, many symptoms occur which apparently vary within wide limits; thus the results of hyper- or hypo- activity may be mild or severe, transient or permanent.

Diseases of the other ductless glands are less common, and rarely cause anything like the marked changes in the general appearance and in the expression of the individual who is affected with hyperthyroidism. Unlike the thyroid, they are not hampered by pure symptomatology, and information concerning them was developed from the pathologic side at the onset.

There has been a determined effort by many observers to apply the old titles of the disease to symptoms caused by the overactive thyroid and to neglect the study of the gland, a practice which very often prevents a recognition of the condition at a period when simple measures might have been employed to cure or to check it.

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Hyperthyroidism has been observed and well described for the past one hundred and twenty-five years. In the early part of this period, Morgagni, Parry, and Flagani, carried their observations up to the Graves period (1835). Five years later Basedow revised the work on this subject, and in 1858, at the suggestion of Hirsch, this syndrome of symptoms was generally designated "morbus Basedowii," a term still commonly employed on the continent.

It may be said truly that every case of hyperthyroidism is not a case of Graves' disease or Basedow's disease, *i. e.*, a patient may present all of the symptoms commonly seen except exophthalmos, which may delay applying the term Graves' disease to the case until this missing symptom appears a month or two later. Descriptions of the condition given by Graves and Basedow were undoubtedly based upon a number of well-marked cases presenting the majority of symptoms common to the condition. Histories well taken, however, will show that many of these cases were not recognized at the beginning as Graves' disease, and that they were treated, perhaps for months, for intestinal toxemia because of the patient's emaciated appearance, and serious stomach and bowel disturbances, or they have been treated for endocarditis until the missing symptom, exophthalmos, developed to prove the exact condition. Still another series of histories will show that the goiter did not appear except as a late symptom, and again, it had existed as a simple goiter without symptoms for several years preceding the development of the well-known changes of the condition.

We have, then, different degrees of hyperthyroidism which may furnish grounds for a reasonable discussion as to whether the change may not at times be a physiologic one of a temporary nature as is seen in changes in the thyroid at certain times, *e. g.*, during menstruation, pregnancy, puberty, etc., due to the intimate association of the gland with the generative organs in the female.

While it is apparently essential that an increase of thyroid parenchyma should be shown in well-marked cases of hyperthyroidism, in the milder cases it is not necessary that the microscopic picture should be more marked than such evidence of cell increase, as is seen in the lactating mammary gland.

There are numerous instances where cases of hyperthyroidism have run rapid courses to death, which were essentially due to toxemia. However, the greater number of these cases live through the stage of simple hyperthyroidism, and should they die eventually their death is usually due to secondary changes in the heart, liver, and kidneys, from the degenerative changes in the gland. Such changes, and the results of them, are seen even when the gland is in an irregular or constant condition of hyposecretion, secondary to a previously overactive secretion.

The term exophthalmic goiter may not even be descriptive of the condition, as in the early stages of the disease some patients may not have goiter, and others may not have exophthalmos, and both of these symptoms may be absent in rare cases. In fact, of the numerous symptoms by which we identify the disease, there is no one symptom the presence of which is necessary to the making of a correct diagnosis.

There are some forms of myocardial disease which may cause severe symptoms common to hyperthyroidism as well. In certain cases of nephritis there may be symptoms in common, especially widening of the palpebral fissure, or Dalrymple's symptom in Graves' disease.

It is difficult to determine just what is the etiology of hyperthyroidism. Some patients give a good history of severe mental strain or nerve shock, yet this exciting cause might be but a slight factor in upsetting the equilibrium of the nervous system of a patient who up to that time had been neutralizing an excess of secretion from the thyroid. Probably more frequent than any other one cause of this condition is that of infection, with tonsillitis the most frequent antecedent.

Halsted's work on this subject developed the fact that the removal of one lobe in dogs caused an increase in the parenchyma of the remaining lobe resembling conditions in exophthalmic goiter.

Marine has shown that the withdrawal of or administration of iodin to dogs affected with colloid goiter caused increase or reduction in the size of the growth.

In the microscopic examination of several hundred exophthalmic goiters Wilson has shown that the history of the individual corresponded to the microscopic changes in the gland in 80 per cent. of the cases. In some of the cases which did not show corresponding changes, it was evident that the section examined did not represent the typical changes of the gland.

From an extensive experience in the examination of thyroids removed in Graves' disease, MacCarty has advanced the revision theory, *i. e.*, that there is a tendency in the gland of hyperthyroidism to revert toward the simple form of goiter at some period of the disease in practically all cases which are not progressive, and also that such reversions may occur at any period or stage of the disease. Certainly this hypothesis is borne out in practice, as we are constantly seeing patients in whom exophthalmos and a small goiter are the only symptoms left after an attack of hyperthyroidism of the most severe type which occurred many years before. Most of the severe cases of hyperthyroidism give a history in which recurring spells of exacerbation of symptoms are well marked. Under such circumstances it is difficult to gage accurately the effect of remedial measures, or to say whether such remission, which has occurred repeatedly, is characteristic of the disease or due solely to measures employed in the treatment, or whether they improved in spite of the remedy.

Pathologic findings in ordinary hyperthyroidism show an increase in the parenchyma of the gland, and an increase in the number of cells lining the alveoli in single or multiple layers, and again by an increase in the number of alveoli.

The pathologic picture of cases of hyperthyroidism which have developed upon long-standing simple goiters is one of papilloma, mostly invaginations projecting into the lumen of the vesicles. These projections are covered by new epithelium and constitute the source of the increased secretions. Both of these forms are common and present all the symptoms of the condition, although the latter form is more commonly associated with the degenerative changes in other organs.

There is another form of hyperthyroidism, unilateral exophthalmic goiter, in which the symptoms may be well marked with the exception of exophthalmos. The eye symptoms are present, *i. e.*, Dalrymple's widening of the palpebral fissure showing more sclera, and Stellwag's sign, staring without widening. In these cases attacks are remittent with periods of exacerbation of a few weeks, and a quiescent period of a few weeks or months. The tumor is unilateral and consists of an encapsulated adenoma which causes irritation and pressure absorption of the nearly normal thyroid surrounding it, when from time to time there is an increase in the growth of the tumor. Such cases would be properly placed with those classified as *pseudo* or *fruste* Graves' disease.

In an examination of a large number of cases of hyperthyroidism (it now numbers over one thousand operated cases) it has become evident to us that there is a condition of increased parenchyma in the thyroid marked by the evidence of hyperthyroidism, and that these symptoms do not necessitate early stages, at least that there should be any serious degenerative lesions of the heart, liver, etc. When such degenerations occur, there is usually a preceding or accompanying degeneration of portions of the thyroid gland.

We have two groups of cases of hyperthyroidism: First, the simple goiter without symptoms of hyperthyroidism, and, second, the group of cases in which the symptoms of hyperthyroidism constitute the main feature of the case. In cancer of the thyroid it is not uncommon to see marked hyperthyroidism; in fact, some cases have every symptom ordinarily classed as Graves' disease.

Treatment.—Admitting the apparent hypothesis that some cases improve with, without, or in spite of treatment, *e. g.*, drugs, mental suggestion, applications, external or injected, *x*-ray and galvanism, injections of boiling water, rest, dietetics, change of climate, operations upon the sympathetic nerves, upon the blood-supply, and upon the gland itself—a full list from which we may choose a remedy.

From an operative standpoint we will consider the operation of vessel ligation, and one of partial extirpation of the gland. For the mild cases and those seen early, we recommend the simple ligation of the vessels, nerves, and lymphatics at the upper pole, with a linen ligature. Following this procedure the reduction in the delivery and production of secretion seems to bring about that form of reversion of goiter toward the simple type, as has been demonstrated by MacCarty. The same treatment is indicated in the more advanced cases in which the changes in the heart, liver, etc., have advanced to a most serious degree. In this group the improvement is very marked in all who recover from the operation, and the removal, secondarily, of the larger lobe and isthmus can be made with a marked degree of safety a few months later. Of the patients operated upon by ligation and who are below weight, there is an average gain of 20 pounds in four months.

In order that an operation of any kind may be accomplished with a minimum risk in these cases, it is often necessary to use various methods of preliminary treatment, such as rest, *x*-ray, and medicinal remedies to improve the heart and kidneys, even before the ligation of one pole is attempted. However, the majority of cases may be operated upon when they come to the surgeon, by the removal of one lobe and isthmus approximating three-fifths of the gland. The unilateral exophthalmic type is a safe one for extirpation of the offending lobe.

The anesthetic, whether general or local, and whether ether or some other drug is used, depends, possibly, more on the individual likes of the surgeon, the necessities and conveniences of the occasion, than upon the condition of the patient. Personally I use cocain when the signs of degeneration in the heart and liver are so marked that we fear the consequences of ether. All general anesthetics are preceded by $\frac{1}{6}$ to $\frac{1}{4}$ of a grain of morphin, with $\frac{1}{120}$ grain of atropin, given twenty minutes before the operation. Cocain anesthesia is often preceded by scopolamin, $\frac{1}{200}$ to $\frac{1}{150}$ of a grain fifty minutes before the operation.

Disability approximates a few days. The results are about 70 per cent. cured and the remainder greatly improved, although operated upon at a time when serious and incurable conditions of other organs were present. The mortality for ligation of vessels is 3.7 per cent. The mortality in extirpation cases is 3.9 per cent. This includes the highest mortality of early work. During the past three years twelve cases have died medical deaths (not operated) within the first eight days after their arrival in the city for operation. Their morbid condition was too evident for surgical treatment at that time.

A CONSIDERATION OF SURGICAL METHODS OF TREATING HYPERTHYROIDISM*

By CHARLES H. MAYO

It is only within a comparatively recent period that our knowledge of diseases of the human body has progressed beyond new-growths, degenerations, and infections. At the present time there is a return to the study of physiology, and many investigators are working actively on the normal and abnormal functions of the various glands of the body. While all of the glands may be classified as nutritive, eliminative, and protective, they are, nevertheless, so intimately associated in their function that it is difficult to estimate observations made upon healthy animals that are unable to record their sensations. In some of these cases the glands studied are evidently of much less importance in the economy than are the same glands in the human being.

The glands of elimination are provided with ducts, as are some of the glands of nutrition, and they are subject to intermittent discharge, while a few of the more necessary glands, so far as their secretion is concerned, are slower in delivering an active secretion through the lymphatic system. The thyroid, parathyroid, and pituitary glands to belong the latter classification.

It is difficult to estimate the degree of hyposecretion. Its entire absence could occur and ill effects be prevented by the activity of other glands of associate function. It is equally difficult to estimate the quantity of oversecretion which may be neutralized by the glands and organs of elimination.

From observations made in over 2,000 operated cases of thyroid disease, it is evident that there is a wide range in the changes manifest in the gland before it produces symptoms which we are able to recognize. Most of these glands are securely hidden from view, and observations as regards their condition have been developed upon the firm basis of pathologic study rather than the far less accurate observation of symptoms.

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For a century and a quarter many observers reported well-investigated cases of hyperthyroidism from the standpoint of symptoms, and it was not until twenty-five years ago that Moebius advanced his theories regarding the disease known as exophthalmic goiter, Morgagni's disease, Flagani's disease, Graves' disease, and Basedow's disease, a condition due to an increase or perversion of secretion of the thyroid gland. The thyroid gland, which is usually accessible and even visible in the neck, is but little in advance of the other ductless glands in having established an accurate record of its diseases. The thyroid gland is of invertebrate origin and was originally a sex organ. This association is still retained, and is seen in the goiter of adolescence, in the goiter of pregnancy, and in goiters which not infrequently accompany uterine tumors and the temporary congestion of the thyroid at the menstrual epoch.

The changes seen in the thyroid gland, other than malignant or infectious, will be found to fall into one or more forms of the brief classification given by MacCarty:

1. The process of goiter may be a process of reversion of the thyroid gland to some former function.
2. Hyperthyroidism is a toxemia, the result of absorption of the products of the hyperactive thyroid.
3. The stimulus causing the hyperactivity may be the same that stimulated the thyroid activity in primitive man.
4. This stimulus was then probably a normal stimulus to the gland, just as we have normal stimuli for glandular activity in man in his present condition.
5. This stimulus may still be present in the food or water formed through some process in the intestine or in the metabolism of the body, or it may exist in the air.

6. The types of goiter are probably not types but stages in a general process.

7. Goiter may be classified upon a pathologic basis as follows: (*a*) Cystic goiter (thyroidea cystica); (*b*) hypertrophic parenchymatous goiter (thyroidea parenchymatosa hypertrophica); (*c*) papillary cystic goiter (thyroidea cystica papillare); (*d*) hypertrophic fetal thyroid (thyroidea fetalis hypertrophica); (*e*) fetal adenoma of the thyroid (thyroidea fetalis adenomatosa).

8. Hyperthyroidism always occurs in *b* and *c*, and may occur in *e*.

The surgical treatment of simple goiter is so nearly crystallized that there is little to discuss concerning it. The operative mortality is very low, being reduced to complications and accidents. The operative treatment of hyperthyroidism is an entirely different proposition. The condition itself often causes death, and patients who suffer from it may be incapacitated, helpless individuals for long periods of time.

The greater number of patients who seek relief from goiter are to be found in these two classes; viz., simple goiter and hyperthyroidism. The first condition, which causes more or less pressure, is a nuisance to the individual affected, while the second condition causes ill health, affecting nearly the entire body. The local symptoms or size of the growth are of secondary importance.

It must be admitted that reversion of the structure toward simple goiter may occur at any time or stage of the condition, with, so far as is known, no more cause than that due to its origin. Other cases are apparently favorably influenced by some form of treatment. It is a matter of common observation that hyperthyroidism seldom progresses continuously without intermission toward a fatal termination of gland destruction unless it results disastrously during the first few weeks. It is now generally conceded that a reduction of the secretion is desired in hyperthyroidism, and to this end many varieties of treatment are employed.

From a surgical standpoint the ligation of vessels with nerves and lymphatics included seems to favor a reversion of the hyperthyroid condition to one of simple goiter. Miles Porter believes that the injection of a small amount of boiling water into the gland substance, after the Wyeth method in angioma, accomplishes the same purpose.

The early surgical work in hyperthyroidism, to a large extent, was done upon the most aggravated types of cases which had resisted other forms of treatment. The mortality of early operations made operative procedures almost prohibitive. The present low mortality has resulted less from an increase of operative skill than from a selection of the time for operation with reference to the activity or severity of the condition, and the type or extent of the operation.

The history of chronic hyperthyroidism usually gives many periods of fluctuation from mild to almost moribund conditions. The condition in the majority of cases is not so extreme that a partial thyroidectomy cannot be made with comparative safety. In the severe cases preparation of the patient should be an important consideration before advising any kind of operative interference. Early cases which might possibly be benefited for a time under medical treatment are often delayed until a condition develops which justifies a thyroidectomy. Such cases are now being treated by an early safe ligation of vessel groups at the upper poles. Very serious conditions complicated with dilatation of the heart, fatty degeneration of the heart and liver, nephritis, and possibly edema and cerebral incoördination are also benefited by a ligation of the vessels at the upper poles, at the same time or at separate operations. The mortality in these cases is about the same as it if for thyroidectomy, but the operation enables the operator to make an effort to relieve some of the patients who are so near moribund that an extirpation cannot be considered.

The average gain in weight following operation upon patients below average weight is 20 pounds within four months. At this time, or later, a partial thyroidectomy can be made with almost no mortality, especially if patients who have relapsed are again tided over the exacerbation period by the ligation of one inferior artery, with an interval of a few months before extirpation is made. These conditions are due to an activity of function of the gland, and some few cases do not recover their normal health after operation because either too little of the gland was removed or the remaining portion of the gland increased its size and output of secretion. Such cases require ligation of some of the vessels, and a resection of the remaining lobe may even be necessary at a later period.

Over 1,100 patients have been operated upon for hyperthyroidism in St. Mary's Hospital. The mortality following ligation is 3.7 per cent., and that following extirpation is 3.9 per cent. This includes the high mortality of our early work, when surgical deaths included many that should have been medical. It is true that we could count out continuous runs between deaths of 76 cases and 90 cases, even 150 cases with two deaths, but the general average is not so good. About 70 per cent. of the patients consider themselves cured, and apparently they are well. The others are improved but not well. Unfortunately they were not operated upon until they were suffering from extensive secondary degeneration and cytolysis of the gland. While the operation checked the toxemia, the result may be compared to that following the removal of a bullet from its location in the neck, without removing the damage done by its passage through the body.

The anesthetic given in these cases has usually been ether, preceded by $\frac{1}{100}$ gr. atropin and $\frac{1}{6}$ gr. morphin. Local anesthesia is occasionally considered best for the patient when the general condition is serious or there are heart complications.

PRINCIPLES UNDERLYING SURGERY OF THE SPLEEN, WITH A REPORT OF TEN SPLENECTOMIES*

By WILLIAM J. MAYO

Our knowledge of the function of the spleen has been so vague, and our ability to determine accurately its physical proportions so unreliable, that it has been impossible to recognize diseased conditions until they reached a stage so advanced that splenectomy became a necessary consequence. Therefore surgery of the spleen has been destructive in character. Recent investigations led to the speculation that many of the anemias and associated blood states may ultimately be treated best by operative procedures directed to the spleen and other blood-forming organs.

In its ontogeny the spleen probably goes back to a time before the development of the cerebrospinal nervous system. This is indicated by the fact that its only known nerve-supply consists of filaments derived from the splanchnic sympathetic to the capsule, stimulation of which causes contraction. It is an organ of internal secretion controlled by chemical stimulation through the bloodstream, in many respects resembling the liver. We may surmise that this form of stimulation has been quite adequate for function, otherwise the spleen would be more closely associated with the sympathetic ganglia, as are the adrenals and pituitary body. The internal secretions of the adrenals and pituitary produce their effect not only by chemical stimulation through the blood, but also by direct action on the sympathetic ganglia, which enables a very small amount of secretion to produce widespread results. The sympathetic nervous system can be compared to a piano, the internal secretions being the fingers of the player, or to an internal telephone exchange within a building; and it enables small organs with scanty secretion, like the parathyroids, to work in harmony with other organs of internal secretion.

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Evidently the internal secretion of the spleen is not important, as splenectomy does not produce serious results, the associated organs taking up the function.

A study of the spleen leads to the conclusion that it possesses three distinct functions: First, it takes part in blood-formation, in which it is associated with the bone-marrow, lymphoid and adenoid structures of the body. Second, it is a destroyer of worn-out red blood-cells. Third, it acts as a filter of microörganisms which may be contained in the blood and which are passed thence to the liver, probably for complete destruction and also as an aid to the liver in carrying on certain functions in relation to the metabolism of the food.

The fetal blood is derived from the spleen, liver, bone-marrow, lymphoid and adenoid structures of the body. The liver loses this function some time before birth. In the adult the red cells are largely formed in the bone-marrow, and the white cells in the lymphoid and adenoid tissues, including the spleen. In health the spleen loses its power to develop the red blood-corpuscles and retains that of white cell production only to a limited degree, its chief function being to destroy worn-out red blood-corpuscles. The ancestral blood-corpuscle, from which both red and white have their origin, is probably the mesenchyme cell, a form of lymphocyte which appears first in the fetal blood. In leukemia there is a reversion to the ancestral lymphocyte or fetal type. In the grave anemias there is a tendency to reversion to primitive red blood-cells, showing granular corpuscles of various sizes and shapes.

The spleen receives its blood-supply from the celiac axis, identical in origin with the blood-supply of those important derivatives of the foregut—the stomach, pancreas, and liver. It does not, however, send its blood directly back into the general circulation, but the splenic vein joins the superior mesenteric and gastric veins to form the portal system.

It would appear that the liver, among other functions, neutralizes toxins and kills bacteria which may be picked up by the portal radicals from the digestive tract. Perhaps the spleen with its huge blood-supply acts like a large lymphatic gland performing some analogous function for the general circulation; but that its blood must be still further changed by passage through the liver before entering the general vascular system is shown by the method of venous return. This association of the liver and spleen is shown in the enlarged spleen so often seen in cirrhosis of the liver, and apparently in such cases without especial effect on the constituents of the blood, and also in the late stage of splenic anemia (Banti's disease) is often associated with secondary cirrhosis of the liver.

The first evidence of a spleen is a collection of mesenchyme cells in the posterior mesogastrium close to the developing pancreas. Its growth is fairly uniform, but there is considerable normal variation in size. It is the largest of the ductless glands, being 5 by 3 inches in diameter, weighs about 200 gm., and fits into the curve of the diaphragm behind the ninth, tenth, and eleventh ribs, where it is molded to the fundus of the stomach. It is completely invested by peritoneum and is held in place by two folds of this membrane, the gastrosplenic omentum and the lienorenal ligament, both of which are attached about the hilum.

The blood-vessels in the spleen travel in the trabecular framework to the pulp and Malpighian corpuscles, and quickly lose all but their endothelial coat. The scanty lymphatics are confined to the capsule. The trabecular framework contains much nonstriated muscular tissue, which permits considerable rhythmic change in size during the digestive period.

Its protected situation, covered, as it is, by the lung and overlaid by the stomach and colon, renders it exceedingly difficult to ascertain moderate changes in size. Our ability accurately to map out a moderately enlarged spleen by percussion is open to question. I have examined a number of spleens manually during operation for other causes, and have been surprised at the inaccuracy of the ordinary methods of physical diagnosis made before operation. Comparatively few abnormal spleens are really recognized as such until the splenic border can be palpated below the free margin of the ribs.

Heretofore we have been unable to diagnose with any degree of exactness, until a late stage, the actual physical relations of the spleen to the disease with which it is either directly or indirectly associated. Therefore our only surgical recourse has been splenectomy. It is altogether probable that certain diseases of the blood are due to an excess or perversion of splenic function, which could be controlled by operative diminution of its blood-supply through ligation of an arterial division, or, by partial splenectomy, just as the thyroid gland is treated in Graves' disease.

I believe that surgeons can do much to establish a better understanding of the relation of the spleen to the anemias by routine examination of this organ during abdominal operations where an altered blood-state exists.

Splenic enlargements, other than tumors, can be grouped in three general classes:

First, leukemias, in which the spleen pulp becomes converted into tissue resembling bone-marrow, and in which the spleen, in connection with all the blood-forming organs, rapidly produces white blood-corpuscles of the ancestral type, much as epithelial cells run riot in cancer—a probable reversion to the fetal form of blood.

Second, splenic anemia, the type in which the enlargement of the spleen is accompanied by a diminution of and change in character of the red blood-corpuscles—apparently an excess of the adult function of the spleen, producing an unnecessary destruction of the red corpuscles.

Third, splenomegalia, an enlargement of the spleen of unknown causation, without marked blood-changes or any apparent serious interference with the health other than mechanical. This class is one of convenience only, and is closely related to the splenic anemias.

In addition to these three classes, two conservative groups of enlargement of the spleen may be recognized. First, the compensatory splenic hypertrophy which accompanies cirrhosis of the liver, and, second, enlargements which are the result of infectious diseases, *i. e.*, tuberculosis, typhoid, syphilis, and malaria (ague-cake).

The sheltered situation of the spleen renders approach for purposes of operation exceedingly difficult unless the organ is more or less movable, which happens in a considerable percentage of cases.

We have usually made an incision through the left semilunar line and, if necessary, carried the upper end along the costal margin to the ensiform cartilage. Willy Meyer has added greatly to our means of approach by mobilization of the overlying chest-wall. "The seventh, eighth, ninth, and tenth costal cartilages are divided with the knife immediately in front of the ribs, also the union of three at the sternum." As yet, however, we have not found the Meyer procedure necessary. · In some cases a left transverse incision joining the longitudinal will be found convenient.

In advanced disease adhesions will often be encountered, especially to the diaphragm, the separation of which will occasionally be difficult until after the splenic pedicle has been secured.

The most important step in the operation, if the vessels are fairly sound, is to grasp the vascular pedicle temporarily in rubber-covered elastic clamps. This must be done with great care, as the splenic veins are very delicate and tear readily. To grasp securely the pedicle of a large spleen the organ should, if possible, be "turned turtle," or at least sufficiently so to enable the hand to grasp the splenic vessels. With the fingers and blunt dissection a passageway is made around the pedicle and the elastic clamp applied and tightened down sufficiently to control the circulation until the spleen can be entirely separated from its attachments and delivered outside the wound. If splenectomy is the object of the operation, the pedicle can be secured at any time after the application of the elastic forceps, which are applied as close to the root as possible so as to leave ample space distal to the forceps for ligation.

If partial resection is to be done, temporary compression of the pedicle seems to be harmless unless there are gross vessel wall changes, and after the application of the clamp the desired amount can be resected and the hemorrhage controlled by buttonhole catgut suturing with a round needle, in a manner similar to that of resection of the liver.

It has been shown experimentally that reduction of the arterial supply by ligation results in atrophy of the spleen, and that as long as the veins are left intact, necrosis does not occur. If the splenic artery divides in the hilum, ligation of branches would appear to be an active competitor of partial splenectomy. We have not found the marked alterations in the walls of the blood-vessels which have been shown to be often present at postmortem and which probably represent a terminal condition.

Our experience in surgery of the spleen has been limited to thirteen cases, three of which were conservative operations. One case was a gunshot injury in which hemorrhage from the lacerated spleen was readily controlled by buttonhole catgut suturing and gauze packing. In the second case a movable spleen with severe attacks of pain from torsion of the pedicle was cured by fixation by means of suture and gauze packing. The third operation consisted of evacuation and drainage of a typhoid splenic abscess four months after the initial attack of typhoid fever.

Ten splenectomies were performed, with nine recoveries. One case was a huge lymphosarcoma. The patient is alive and well now, over three and a half years after operation. The second case was one of tuberculosis of the spleen with primary recovery; present condition unknown. Four cases were splenic anemia; all of the patients recovered and were either entirely cured of their anemia or were greatly improved. Two cases were Banti's disease; one patient recovered and one died. Two cases were splenomegalias, that is, enlarged spleens of unknown origin. Both patients recovered.

Subsequent to four of the splenectomies for splenic anemia the patients complained of pain in the long bones at intervals for several months.

I would call the attention of those especially interested in splenectomy to the very able papers on the subject by J. Collins Warren* and George Ben Johnston.†

A brief history of the ten splenectomies has been compiled by Donald Guthrie, and is herewith appended.

Case 1 (617 G).—Miss B., aged sixteen, for three months had had attacks of rather sudden pain beginning in the back and referred around the left costal arch, severe at times, usually lasting a half hour to two hours; no nausea or vomiting; pain not attributed to food; no loss of weight.

Examination.—Anemic young girl; heart and lungs negative; stomach large and splashy; tumor in left hypochondrium extending downward and forward to midline; palpation showed it to be spleen. Pelvis negative, urine contained albumin and casts. Blood: Hemoglobin, 75 per cent.; reds, 4,000,000; whites, 4,000. Diagnosis, splenic anemia.

Operation.—April 7, 1904; splenectomy. Pathologic condition: tuberculosis.

Present condition unknown.

Case 2 (3539 P).—Mrs. M., aged forty-one, married ten years, with two children, youngest aged four, no miscarriages, menstruation regular, had had from eight to ten years of age repeated attacks of malaria; none for fifteen years. Health was perfect until four years before coming under observation. After birth of last child patient noticed enlargement in region of spleen; it was not noticed again until seven months before examination. The past four to six months there had been some dyspnea with anemia, beginning at that time.

Examination.—Fairly well-nourished woman, anemic, heart and lungs negative, huge tumor extending from fifth rib down across abdomen 1 inch past midline into pelvis, notched. Liver extended 1 inch below costal margin, pelvis negative. Blood: Hemoglobin, 50 per cent.; reds, 4,504,000; whites, 4,600. Urine negative.

Operation.—November 14, 1905. Splenectomy. Adhesions to tail of pancreas, a small piece of which was removed. Gastrohepatic ligaments and adhesions to diaphragm ligated. Some free ascitic fluid. Recovery good. Pathologic report: lymphosarcoma of spleen, weighing 2,375 gm. (8.67 pounds).

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* Warren, J. C.: "Ann. Surg.," 1901, xxxiii, 513–533.

† Johnston, George Ben: "Ann. Surg.," 1908, xlviii, 50–65.

More than three years later the patient is enjoying splendid health; has gained 40 pounds in weight.

CASE 3 (8869 G).—Miss S., aged twenty-seven, had known of enlargement in left abdomen for fifteen years. She had frequent attacks of digestive disturbance with anemia; two years before coming under observation she had a first attack, lasting five days, of acute pain in the upper abdomen, followed by edema; two weeks later a similar attack; then she was perfectly well for nine months. The following summer she had acute pain in left hypochondrium with much soreness in region of spleen; was well until summer before operation, when she became weak and much depressed. Three months before operation she had an attack of violent pain through the back, arms, and left side of the abdomen lasting four days, followed by general edema; was ill for seven weeks.

Examination.—January 6, 1907. Anemic young woman. Slight icterus; edema present about ankles and face, heart and lungs negative, huge tumor extending from under left costal arch downward and forward to the right, past the midline, filling the whole abdomen, and into the pelvis. Tumor hard and notched. Liver enlarged 3 inches below costal arch, pelvis negative, urine negative. Blood: Hemoglobin, 80 per cent.; reds, 5,200,000; whites, 4,800. Diagnosis, Banti's disease.

Operation.—January 7, 1907. Splenectomy. Spleen adherent to diaphragm and stomach. Some adhesions to omentum and abdominal walls. Large white cheesy spots on surface. Accessory spleen entirely separate at the base of the omentum, size of pullet's egg, nearly round and very movable; not removed. Hypertrophic cirrhosis of liver with perihepatic adhesions. Ascites, several quarts of fluid. Omentum placed in adherent area to secure adhesions. Patient died twelve hours later from shock and hemorrhage. Pathologic report: chronic hyperplasia, spleen weighing 11 pounds, 12 inches long, 8 inches wide, 3 inches thick.

CASE 4 (1074 P).—Mrs. McD., aged twenty-seven, had two children, youngest aged three. Menstruation was normal; patient had had poor health for years; sick headaches every two to four weeks. For a year she had been weak, tired, and unable to work. During this time she had a sharp pain at menstrual period radiating from the left costal arch to the clavicle. She had known for a year of splenic enlargement, which had grown slowly.

Examination.—Fairly well-nourished woman, pale; heart and lungs negative; spleen extended 4 inches beyond midline and filled the pelvis, hard and notched. Uterus retroverted; urine negative. Blood: Hemoglobin, 57 per cent.; reds, 5,388,000; whites, 3,000; polymorphonuclears, 42 per cent.; lymphocytes, 58 per cent. Diagnosis, splenomegalia.

Operation.—May 17, 1907. Splenectomy and extensive suturing of adhesions to diaphragm and under surface of liver to check oozing. Gauze drain through left loin. Recovery good. Pathologic report: chronic hyperplasia. Weight, 6.33 pounds.

Patient now enjoys excellent health.

Case 5 (9315 A).—Miss T., aged thirty-seven, menstruation normal; eight months before coming under observation noticed enlargement and hardness in left side of abdomen under costal arch. Steady growth to present size. General health fair.

Examination.—Fairly well-nourished woman, pale; heart and lungs negative; large tumor extending from under left costal margin downward and forward into the pelvis a few inches above symphysis, sharp-edged and notched. Urine contained albumin, granular casts, a few leukocytes. Blood: Hemoglobin, 49 per cent.; reds, 4,100,000; whites, 4,600. Cystoscopic examination negative except that catheter met an obstruction in left ureter, probably due to pressure of tumor, which was easily passed. Diagnosis, splenic anemia.

Operation.—May 11, 1908. Splenectomy, spleen 12 inches long, 8 inches wide, 3 inches thick. Peculiar mottled appearance. Pathologic report: chronic hyperplasia. Weight, 10¼ pounds.

Patient's health is now excellent; she has returned to work.

Case 6 (A 11038).—Mrs. W., aged thirty-nine, had two children, youngest aged fifteen. Menstruation regular. Patient had been operated on elsewhere two years ago, left nephrorrhaphy. For ten years she had had a dull aching pain and a sense of pulling in the left lumbar region; for years severe migraine attacks, requiring morphin and chloroform. There was much tenderness over abdomen and pain at left costal arch referred into the lumbar region. A tumor was to be felt in the region of the spleen and left kidney.

Examination.—Thin woman, pale; heart and lungs negative. Tender at left costal arch and in lumbar region; pelvis negative; urine negative; cystoscopic examination negative. Blood: Hemoglobin, 80 per cent.; reds, 4,000,000; whites, 14,000; polymorphonuclears, 56.6 per cent.; lymphocytes, 43 per cent.; eosinophiles, 0.3 per cent.; basophiles, 0.1 per cent. Diagnosis, splenic anemia.

Operation.—Splenectomy, June 27, 1908. Pathologic report: chronic hyperplasia. Weight, 350 gm.

The patient's present health is good.

Case 7 (A 10324).—Mrs. L., aged forty-nine, had two children, youngest aged twelve; no menstruation for two years. Nine months before coming under observation patient noticed tumor in the left abdomen which had grown gradually. Patient had become weak but lost little in weight; had some edema of feet at times; no urinary disturbance.

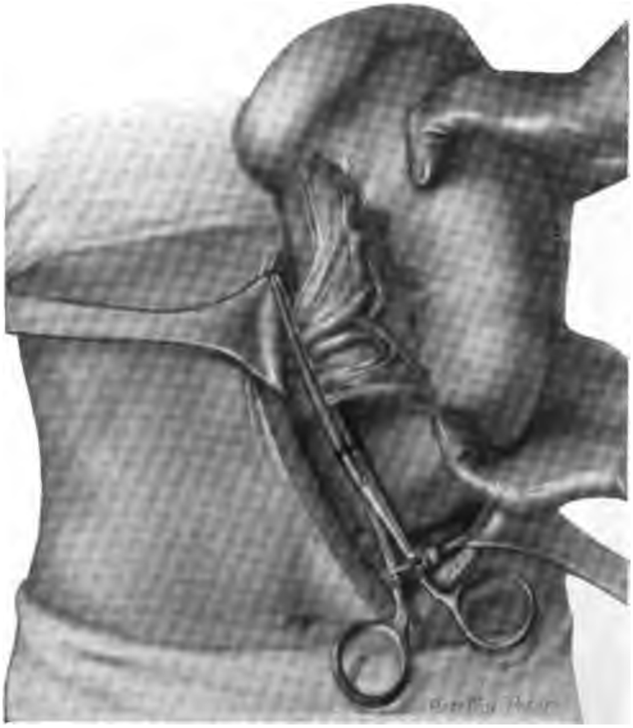

Fig. 275.—Temporary compression of the vascular pedicle of the spleen.

Examination.—Fairly well-nourished woman, pale; heart and lungs negative; large tumor in the region of the spleen, sharp-edged and hard. Cystoscopic examination negative. Pelvis negative. Blood: Hemoglobin, 70 per cent.; reds, 2,960,000;

whites, 6,200. Polymorphonuclears, 93 per cent.; lymphocytes, 4 per cent.; eosinophiles, 3 per cent. Diagnosis, splenic anemia.

Operation.—July 2, 1908. Splenectomy, spleen filling whole of left of abdomen to median line, notched on posterior surface. Adherent to under surface of diaphragm, to tail of pancreas, and to the posterior wall of stomach. Removed with difficulty. Pathologic report: chronic hyperplasia. Weight, 7 pounds.

After operation patient was very ill with pneumonia, but recovered. Three letters report steady improvement. She is now in good health.

CASE 8 (A 18026).—H. N., male, aged twenty-six, had had pain in epigastrium and left costal arch, on and off for two years; weak, tired feeling of late. He had lost 20 pounds in the last two years; no urinary disturbance.

Examination.—Poorly nourished young man; heart and lungs negative. Mass in left hypochondrium, moved downward to level of umbilicus on inspiration, rather soft, no sharp edges. Urine negative. Blood: Hemoglobin, 88 per cent.; reds, 4,100,000; whites, 10,200; polymorphonuclears, 65 per cent.; lymphocytes, 22.5 per cent.; eosinophiles, 2 per cent.; basophiles, 0.5 per cent.; transitional forms, 5 per cent. Diagnosis: splenomegalia, abdominal tumor from enlarged spleen.

Operation.—December 30, 1908. Splenectomy, spleen extending a hand's breadth below the rib margin to midline. A number of accessory spleens in pedicle which were not removed. Recovery good. Pathologic report: chronic hyperplasia. Weight, 430 gm.

Patient is much improved and able to work.

CASE 9 (A 20818).—Dr. K., aged thirty, had had malaria in 1898; was told that spleen was enlarged. Four years before coming under observation, after being in Cuba fifty-one days, he had amebic dysentery. Amebæ were found in stool only second summer, but patient had three summer attacks lasting several months each time. General health was apparently good except for pallor. Weight same, 150 pounds, until April, 1908, when he vomited up some blood and passed large amount by bowel; in May, 1908, he had similar hemorrhage just after a meal. Case was diagnosed as ulcer of the stomach. Fasting treatment given. Two months later he had bloody stools. Blood-count taken: hemoglobin, 50 per cent.; reds, 3,500,000; whites, 3,000. Splenic enlargement found, which had been noticed in 1898. In August, 1908, patient had severe hemorrhage by mouth and bowel; was confined to bed, very weak and anemic. In October, 1908, he was getting ready for gastroenterostomy, when he had the most severe hemorrhage of all. Hemoglobin dropped to 15 per cent. and reds to 1,000,000. In September, 1908, he had ascites, was tapped six times since; 4½ to 9 quarts obtained each time, last tapping one week before examination.

Examination.—Thin young man, very pale and sallow, heart and lungs negative. Weight, 140. Appetite good, bowels and urine in good condition. Tumor in left hypochondrium, extending from sixth rib down and forward to level of umbilicus, 1½ inches extent to midline. Tender, hard but not notched, liver small, extending from fourth to eighth rib; ascites marked; separation of recti. Blood: Hemoglobin, 47 per cent.; reds, 3,300,000; whites, 2,500. Small lymphocytes, 17.5; large, 7. Polymorphonuclears, 73; transitional forms, 5 per cent.; eosinophiles, 1.5; basophiles, 0.5. Diagnosis, Banti's disease.

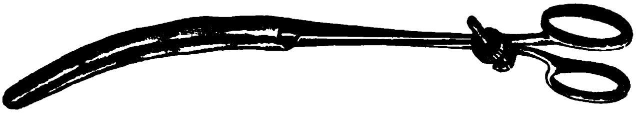

Fig. 276.—Lower's forceps for compression of the pedicle of the spleen.

Operation.—March 4, 1909. Splenectomy. Ascites. Liver cirrhotic. Pathologic report: chronic splenitis. Weight, 1180 gm. Patient was aspirated on tenth day; four quarts removed; fluid did not reaccumulate. Improvement in blood and weight good. Patient is gaining rapidly.

CASE 10 (A 22026).—Mrs. B., aged fifty-three; mother died of spleen trouble; father of tuberculosis at seventy-nine. Patient had had no children, no miscarriage; menopause six years before coming under observation. At twenty years of age patient was in bed twelve weeks with articular rheumatism. For eight years, off and on, she had pain or ache in epigastric region, usually steady for a month, then relief for four to eighteen months or more, with perhaps two or three days' ease at a time, during period of attack. She said a little blood would come up in the mouth during spell, and ease would follow for a day, but there was no cough or vomit, no food distress, no loss of appetite and only a little loss of flesh in the past six months. She had had no bowel complaint since November, 1908. Ache in epigastrium had been steady. Late in December patient noticed a hardness in epigastric region, more to left.

Examination.—Well-nourished woman, pale, skin wrinkled and dry, heart and lungs negative. Tumor extended down and forward from sixth rib, left side to level of umbilicus, 1 inch inside midline. Tumor moved on respiration, notched and tender. No ascites found. Blood: Hemoglobin, 68 per cent.; whites, 2,500; reds, 3,600,000; small lymphocytes 23, large 3; polymorphonuclears, 72; transitional forms, 1; basophiles, 1. Urine, sp. gr. 1,020, acid, trace of albumin, few hyaline and granular casts. Diagnosis, splenic anemia.

Operation.—April 13, 1909. Splenectomy. Pathologic report, chronic splenitis, typical sago appearance. Weight, 8 pounds.

Patient's present condition is good.

CONGENITAL UNION OF SPLEEN AND LIVER*

By BYRD C. WILLIS

Possibly the congenital union of spleen and liver has been observed a number of times, but in a careful search of the literature at my command I find none reported. Other anomalies, such as complete absence of the spleen, aberrant and accessory spleens have been recorded by various observers, and I merely wish to add another variety of anomaly to the list.

In a necropsy held at St. Mary's Hospital, January 1, 1910, upon the body of Mrs. A., aged thirty-three, who died following an operation upon her generative organs, as the hand was run along the upper surface of the liver beneath the diaphragm, the left lateral ligament was felt some 3 inches to the left of the falciform ligament. On depressing the distended stomach, I observed that the spleen and liver were in apposition and firmly united at this point. The liver did not extend over to the left more than usual, and was fairly normal in outline. The spleen was cephalo-lateral to the fundus of the stomach, and its entire right lateral border (4 inches) was attached to the left lateral border of the liver. The left lobe of the liver, with the spleen attached, was removed after the detachment of the ligament from the diaphragm. There were no inflammatory adhesions to the diaphragm.

Fig. 277 is a photograph of the superior surface of the liver and upper surface of the spleen, viewed from in front and above, showing the union and the remnants of the ligament.

Microscopic examination revealed the two capsules in firm

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* Reprinted from the "Old Dominion Jour. of Med. and Surg.," vol. xi, No. 2, Aug., 1910.

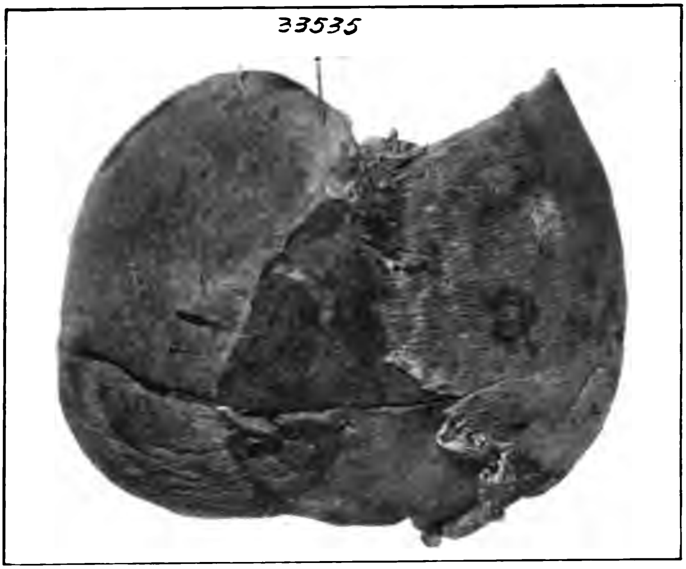

Fig. 277.—Photograph of liver and spleen, showing the union and remnants of ligament.

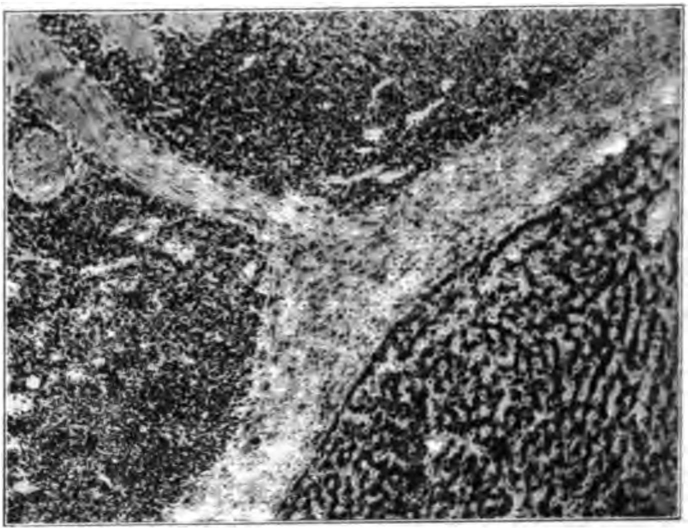

Fig. 278.—Photomicrograph, showing union of the two capsules with normal liver and spleen on either side.

union, there being a normal liver and spleen (except some congestion of latter—either side of respective capsules, as is shown in photomicrograph, Fig. 278).

The patient had exhibited no symptoms of the abnormality and its presence had not been discovered by either the clinicians or the surgeons. The close apposition of the liver and spleen in the embryo, especially during the early stages of their development, gives a ready explanation of the cause of the anomaly.

HEAD, NECK, AND EXTREMITIES

THE EXAMINATION OF THE NOSE AND THROAT IN RELATION TO GENERAL DIAGNOSIS: RESULTS IN ASTHMA FOLLOWING NASAL OPERATION*

BY H. Z. GIFFIN

In a consideration of the relation between nose and throat affections, and other diseases which are met by the general practitioner, two facts must be kept in mind: first, that the patient's general condition affects the mucous membrane of the nose and throat, and, second, that abnormal nasal conditions affect the general health. It is well known that the nasal mucous membranes are more or less abnormal in every affection which impairs the general health. On the other hand, there are undoubtedly many cases in which the bad general condition is at least in part due to unrecognized trouble in the nose and throat. We willingly look upon diseased adenoids and tonsils as harmful, but we do not seem to be so much awake to the fact that other nasal conditions are nearly, if not quite, as important. Even though prejudice exist in the matter, this should not be an excuse for failure to examine the nose and throat, as is often the case. That affections of the nose and throat are not being carefully considered is constantly brought to one's attention. A patient with pronounced nasal symptoms may have visited a dozen physicians, none of whom has examined the nose nor suggested an examination. Meanwhile "catarrh" remedies make fortunes, and the cocain habit increases.

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* This paper is written from the viewpoint of one who is interested principally in medical and surgical diagnosis, and, therefore, it lacks the merit of technicality which might be given by the rhinologist. Read before the Southern Minnesota Med. Assoc., Aug. 4, 1910. (Reprinted from the "Boston Med. and Surg. Jour.," Feb. 16, 1911.)

That affections of the nose and throat are credited with an effect out of proportion to their real significance is also true, though this is not done so often by general practitioners.

The specialist who is tempted to jump to the conclusion that nasal disorders can cause everything, in all degrees of severity, should protect himself by accepting the opinion of those who deal intimately with general treatment. Evidence must be weighed after a general physical examination has been made before deciding upon the significance of any existing nasal condition. The specialist who completes the toilet of his "hundred patients a day" by means of sprays and nebulizers is doubtless filling a popular demand, but he is also a purveyor of mental suggestion in a manner which has little to commend it.

By nasal treatment one would better mean the mechanical removal of diseased parts, or obstructive parts, and the drainage of confined pus, *i. e.*, the removal of polypi or hypertrophied turbinates which obstruct breathing, and the drainage of sinuses; and this for the most part by clean-cut surgery. Medicinal treatment doubtless has its place, but should be much restricted.

I shall review in a general way a number of conditions in which nose and throat examinations more particularly suggest themselves, or in which nasal treatment has proved efficacious; and in closing will give some statistics relative to asthma.

The complaints of nasal discharge, of deafness, and of nasal obstruction are so often heard and so easily elicited that one would hesitate to consider them, were it not for the fact that the physician generally dismisses the matter with a passing remark concerning the frequency of "catarrh," and, strangely enough, the patient seems satisfied. These complaints should be heeded and a careful nasal and aural examination made in order to determine just what may be expected from nasal operation or treatment. Polypi, antrum disease, or hypertrophied turbinates may be the cause of the "catarrh."

Acute headaches with fever, no matter to what part of the head the pain may be referred, are often due to sinusitis. The headache is often intense, and one may suspect the onset of a severe general infection. Many times when grippe is diagnosed, whether the influenza bacillus is concerned or not, the severe symptoms are improved upon drainage of an antrum or frontal sinus. Indeed, this is often a more urgent matter than drainage of pus from other parts of the body.

Dull, heavy headaches of a more constant and chronic type, sometimes confined to one side of the head, are quite often due to nasal obstruction or sinusitis. In these cases the turbinates may be hypertrophied or polypoid, and local treatment or operation may be advisable according to the nature of the condition found.

Periodic headaches, or sick headaches, are generally of nervous origin, and nasal operation should be advised only when more serious nasal trouble is found. Something can be learned from examination of the nose during an attack. Even in this type of headache, however, considerable relief, particularly in the severity of the attacks, follows operation in properly selected cases. Indeed, we believe examination of the nose and throat in the various forms of headache to be more important than the examination of the eyes; yet in most of our cases the eye condition has been previously corrected, while the nose and throat have been overlooked entirely.

The association of headache or nasal obstruction with the onset of the patient's complaint, particularly if the complaint be a periodic one, makes us suspect nasal disorder. This is observed in several conditions. Asthma, epilepsy, dizziness, and various stomach and digestive disorders of a milder type are frequently associated with headache. The headache is generally the resultant in these cases, but occasionally it would seem to be the antecedent, and if so one must consider the possibility of nasal influence. Especially have we seen benefit from operation where there is a complaint of morning nausea and vomiting associated with headache, if the patient does not impress one as being markedly neurotic. Many patients complaining of dizziness associated with nasal obstruction or headache have been relieved. The epileptic should have the same careful examination that is required in cases of headache, including the eye, nose, and throat. One does not expect cure of epilepsy to follow operation, but frequently improvement has been observed. Cases certainly should not be operated upon unless decided trouble is found.

The effect of chronic fibroid tonsils upon the recurrence of articular rheumatism and other diseases of the rheumatic cycle should be considered. Cases of chorea will often improve more rapidly after tonsillectomy.

The relation of tonsillitis and sinusitis to the more chronic types of arthritis is indefinite and requires more study.

More particularly must one emphasize the importance of a careful search for all possible causes of severe anemia. Anemia of itself will cause intumescent turbinates and an edematous condition of the nasal mucous membranes. This must be interpreted as secondary. But, on the other hand, an antrum full of pus will make it difficult to improve the blood. I have seen anemics improve rapidly after drainage of an antrum when placed upon the very treatment which had formerly failed.

Patients with facial neuralgia have been operated upon several times before an antrum full of pus was discovered, the pain promptly disappearing after proper drainage.

Tumors of the face and neck, including goiter, should have nose and throat examinations for diagnostic purposes. A few glands high up near the angle of the jaw, even if they are quite large, may disappear rapidly after tonsillectomy. With tuberculous glands of the neck, the tonsils are usually in bad condition, and sometimes it seems best to remove them. In goiter paralysis of a cord may be present even though no hoarseness exists, and if this be not discovered before thyroidectomy, the surgeon is unjustly blamed. One occasionally sees a cyst in which malignancy has been suspected correctly diagnosed as abscess of the antrum by means of nasal examination. Tumors of quite similar characteristics are found upon nasal examination to be sarcomata of the antrum. Cases long treated as ulcerated tooth prove to be abscess of the antrum.

It need hardly be mentioned that mediastinal growths and thoracic aneurism often cause paralysis of a vocal cord, generally the left, occasionally the right, and that the patient is sometimes referred from the nose and throat department for general examination. It is not so well recognized, however, that an apical lesion of the lung may cause paralysis of the right vocal cord.

It is well to know the nose and throat findings where lues is suspected. The diagnosis is often very easily confirmed in this way and occasionally a doubtful case is entirely cleared up. A luetic perforation of the bony septum is easily overlooked. One must be careful, however, not to diagnose every perforation of the septum as syphilitic. Some are traumatic, others trophic or tuberculous, but these are generally perforations of the cartilage.

Irritative cough, especially night cough, may be entirely a reflex matter and sinusitis may be found. This leads directly to a consideration of certain forms of asthma which are apparently influenced by nasal conditions. Our experience with nasal asthma has been moderately encouraging. Every asthmatic is referred to the nose and throat department in the course of routine examination, and selected cases are operated upon; that is, cases which show polypoid growths, sinusitis, or hypertrophied turbinates, which clearly cause nasal obstruction.

During the year 1909, 66 cases of asthma were operated upon by Justus Matthews in the clinic of St. Mary's Hospital. In 35 cases turbinectomy was done; in 26 of these, double middle turbinectomy; in 10 one or both inferior turbinates were also resected. This was the operation of greatest frequency. In 12 cases polyps were removed. In 9 one or both antrums were drained, and in 6 deformities of the septum were corrected. Four cases were in children, and adenoids and tonsils were removed.

In the general examination of these patients there did not appear to be any distinction between the different types of nasal affection discoverable in the symptoms or signs of the asthma. After operation the patients were placed upon small doses of iodid for two or three weeks, as is customary after nasal operations.

Reports have been received from 52 cases, nine months to one and one-half years after operation. Two have since died of unrelated affections. Two are worse than before operation; the attacks are more frequent and more severe and the general health is worse. Thirteen can see no definite change in their condition. The frequency of attacks may be diminished and the severity increased, or vice versa, but they cannot report themselves as better or worse. Thirty are definitely much improved, as to both frequency and severity of attacks, and in their general condition. Five consider themselves cured, which, of course, only means that they have had no attacks since operation. One of these patients had had asthma for twenty years, another for sixteen years.

In other words: definite improvement has followed in 57 per cent., and "cure" in about 10 per cent.

In tabulating the results one finds that in general when the attacks become less frequent they also become less severe. The general health had improved in 33 of the 52 patients. Headache had been a symptom in 31 cases and had improved in 24. Mild stomach symptoms were elicited in 25, and had improved in 20.

Of the operations upon the 5 patients who were "cured," 4 were turbinectomies and 1 was the removal of polyps.

Improvement followed in 3 of the 4 cases in children in which adenoids and tonsils were removed.

The most unusual things will occasionally cure asthma. Looking upon the condition as a spasmodic neurosis, one would, however, expect strange cures. In reality one should not strive for cures only, but should be satisfied with any procedure which will cause improvement in the majority of cases. Nasal operation seems to do this if the patients are previously selected. And there would seem to be good logic in freeing the respiratory tract of anything which might cause reflex irritation.

In conclusion, it may be reiterated that examination of the nose and throat for diagnostic and therapeutic purposes should not be neglected. On the other hand, they are not parts of the anatomy to be needlessly tampered with simply because they are accessible. Like the gynecologist, the nose and throat man may court distrust by over-enthusiastic specialization.

TREATMENT OF TUBERCULOUS GLANDS OF THE NECK*

A STUDY OF 649 OPERATED CASES

BY EDWARD STARR JUDD

Treatment of tuberculous glands of the neck by excision dates from the time of Galen, although the first systematic dissections were probably done by Billroth in 1870 and by Rushton Parker and others in 1871.

Formerly glandular tuberculosis of the neck was supposed to be an expression of general glandular infection, and it was believed that the infection traveled upward from a focus at some point inside the chest. Until the appearance of the comparatively recent study of the anatomy of the lymphatic system by Sappy, Leaf, Poirier, and Cunéo, our knowledge of the source of infection and the avenues traveled by it was very meager.

There are approximately 800 glands in the entire human body, and nearly 300 of these lie within the tissues of the neck. The glands in this region are the first to appear in the embryo. Placed at the juncture of the head and neck are several groups of glands forming a kind of "glandular collar." This collar is composed of:

1. Suboccipital group, whose afferent vessels drain the occipital portion of the scalp; and efferent vessels which pass to the substernomastoid glands.

2. Mastoid group, which is composed of two or three glands receiving drainage from the temporal region of the scalp and ear, and with efferent vessels to the substernomastoid glands.

3. Parotid glands. These glands are again divided into several

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* Read before the Section on Surgery, New York Academy of Medicine, May 19, 1910. (Reprinted from "Annals of Surgery," Dec., 1910.)

groups lying in different relations to the parotid salivary gland. There are from ten to twenty glands in this group; some lying superficially, some within the parotid, and a separate group lying between the parotid and pharynx. The afferent vessels to these glands come from the anterior part of the scalp, ear, eyelids, root of the nose, nasal fossa, and pharynx, and the efferent vessels pass into the deep cervical chain.

4. The submaxillary glands, three to six in number, lie along the lower border of the submaxillary bone. This group drains the upper and lower lip, cheek, nose, side of the tongue, and gums, and empties into the deep cervical chain.

5. Submental glands; a small group lying between the anterior bellies of the digastric muscles, receiving afferents from the lower lip, floor of the mouth, and tip of the tongue, and sending efferents to the submaxillary glands.

6. Retropharyngeal glands. These glands receive vessels from the nasopharynx and drain to the deep cervical chain.

It will be seen that this glandular collar, composed of the six groups of glands, drains the entire scalp, skin, and mucous membrane of the head and face, and that each group sends its drainage to the deep cervical chain. There are no lymphatic vessels passing upward or communicating at any point within the skull.

The descending cervical chain, composed of the glands lying anterior and posterior to the internal jugular vein, and also of those lying in the supraclavicular region, together with the secondary groups, may best be considered in a pathologic or surgical sense as one large group. The deep groups are each made up of a number of large glands. In the upper half of the neck they lie almost entirely behind the sternomastoid muscle, while in the lower division they lie opposite the posterior border and in the supraclavicular triangle. The chain extends from the tip of the mastoid process to the juncture of the internal jugular and subclavian veins. The afferent vessels to this chain are those coming from the groups making up the cervical collar, and also several vessels passing directly to the deep glands from the scalp, tongue, palate, esophagus, and thyroid. The vessels leading from these groups (deep chain-subclavicular-supraclavicular) unite on either side of the neck into one or two large lymphatic vessels called the *jugular trunks;* and these in turn empty on the right side into the internal jugular or subclavian veins, and on the left side directly into the thoracic chyle duct.

The glandular system in the neck terminates on either side in these large lymphatic vessels and has no direct communication with the lymphatic system in the thorax. Poirier and Cunéo, speaking of the afferent vessels of the supraclavicular group, say: "On the other hand, these glands receive no vessels coming from the mediastinal glands. Cases of adenitis following mediastinal or abdominal neoplasms can only be explained by a retrograde thrombosis of the afferent vessels of these supraclavicular glands."

To me it seems very important that we should appreciate this point. A great deal of the incomplete and half-hearted work done in removing these glands has been due to the conviction that the diseased condition extended down into the mediastinal glands. From a more thorough study of the anatomy of this region, we now know that direct extension from the cervical glands into the mediastinal glands is impossible, and, therefore, that inflammations and neoplasms affecting the cervical lymphatics are *local* until they pass into the general circulation.

It is a fact generally accepted that the best treatment of accessible, tuberculous lesions, when they are still local, is that of excision. We know that in cases of tuberculosis of one kidney a very high percentage can be cured by removal. A similar process in almost any of the abdominal viscera, if diagnosed before too extensive, can be excised, and in the large majority of instances no further trouble will occur. The same is true of tuberculosis of the joints, epididymis, etc.

We are seldom able to demonstrate positively the exact avenue of the infection. Occasionally we may find the bacilli in a decayed tooth, tonsil, or lupus area, but more often the point of invasion cannot be found. It has been shown, experimentally, that cultures of tubercle bacilli swabbed over the surface of the tonsil may leave no trace of their passing through that organ, but will invade the glands draining the tonsil. In our cases we were seldom able to trace back to the source of entrance. Examination of several hundred tonsils showed tubercles in much less than 1 per cent. In 1,000 cases 2.3 per cent. had positive tuberculous lesions.

From the histories of our cases of tuberculous glands we find that in 80 per cent. the first enlargement was beneath the upper end of the sternomastoid muscle; in 18 per cent. the first noticeable enlargement was in the submaxillary, submental, or parotid regions. In four cases the first cervical gland to enlarge was in the supraclavicular group. In each of these four cases the axillary glands were also involved, the infection having presumably entered through an abrasion of the finger or hand. Several cases followed closely upon suppurating otitis media.

Indications for Operation.—If we were to make a routine examination of a great number of children between the ages of four and ten, we would find in the majority of them varying degrees of enlargement of the glands. The pathologic changes in these glands, formerly called *scrofulous*, are in part simple hyperplasia, in part tuberculosis. There is no differential diagnostic criterion of the initial stage of glandular tuberculosis. The tissues in these glands predispose and invite tuberculous infection. In this particular type of case our method of treatment has been as follows: First clear the throat of adenoid tissues and tonsils and give such attention as is necessary to the teeth and nose. Assisted by tonics, especially syrup of the iodid of iron, and with outdoor living, this treatment has been sufficient to cure most of these cases. The cases that have been perfectly cured seem to be of the hyperplastic type, or, at least, to have been only invaded to a slight degree by the tubercle bacillus. We have occasionally seen a child with caseating nodes. Such cases require, in addition to the above treatment, removal of the infected nodes and drainage. If the glands still continue to enlarge and other glands become involved, it will be necessary to do a complete excision to effect a cure. Most of the patients upon whom we have done a complete excision of the glands have been over fifteen years of age; 18 in 649 cases were under ten years. In the presence of a discharging sinus, it does not

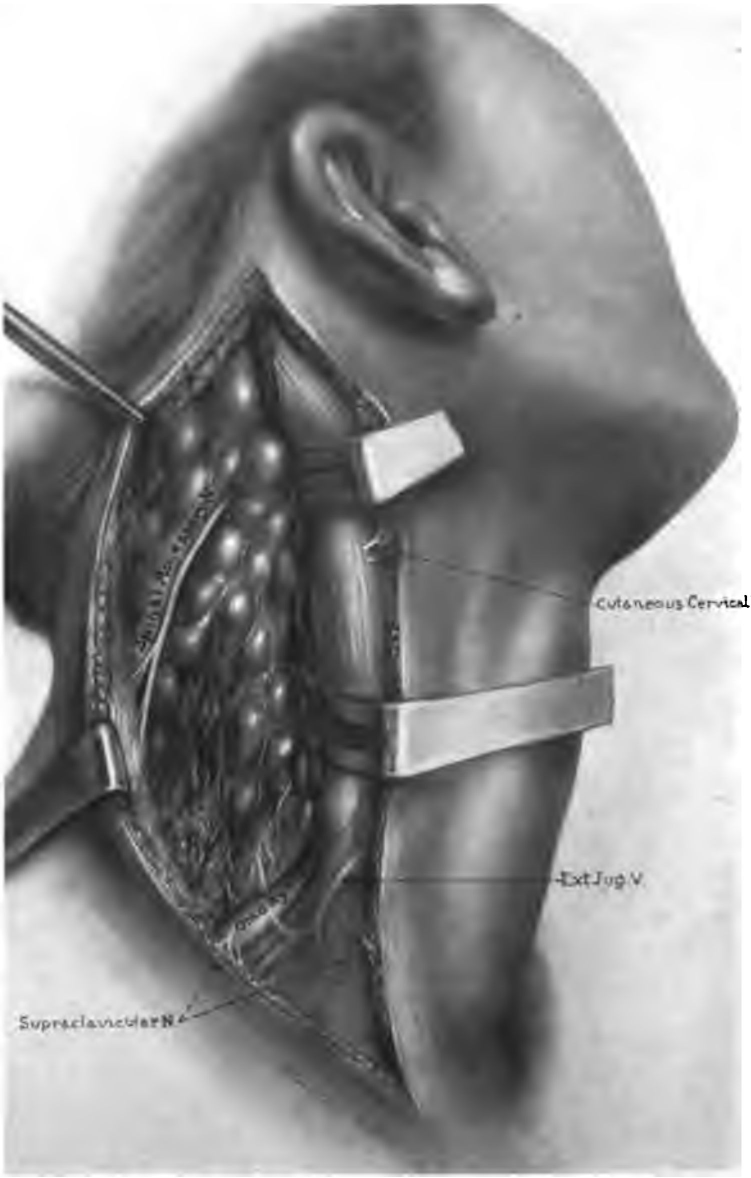


Fig. 279.—Showing the skin and platysma dissected forward and backward. Retractors under posterior border of sternomastoid, exposing glands lying in gland-bearing fascia. The omohyoid marks the lower angle of the dissection, and the mastoid process, the upper. The spinal accessory nerve is partly dissected from among the glands.

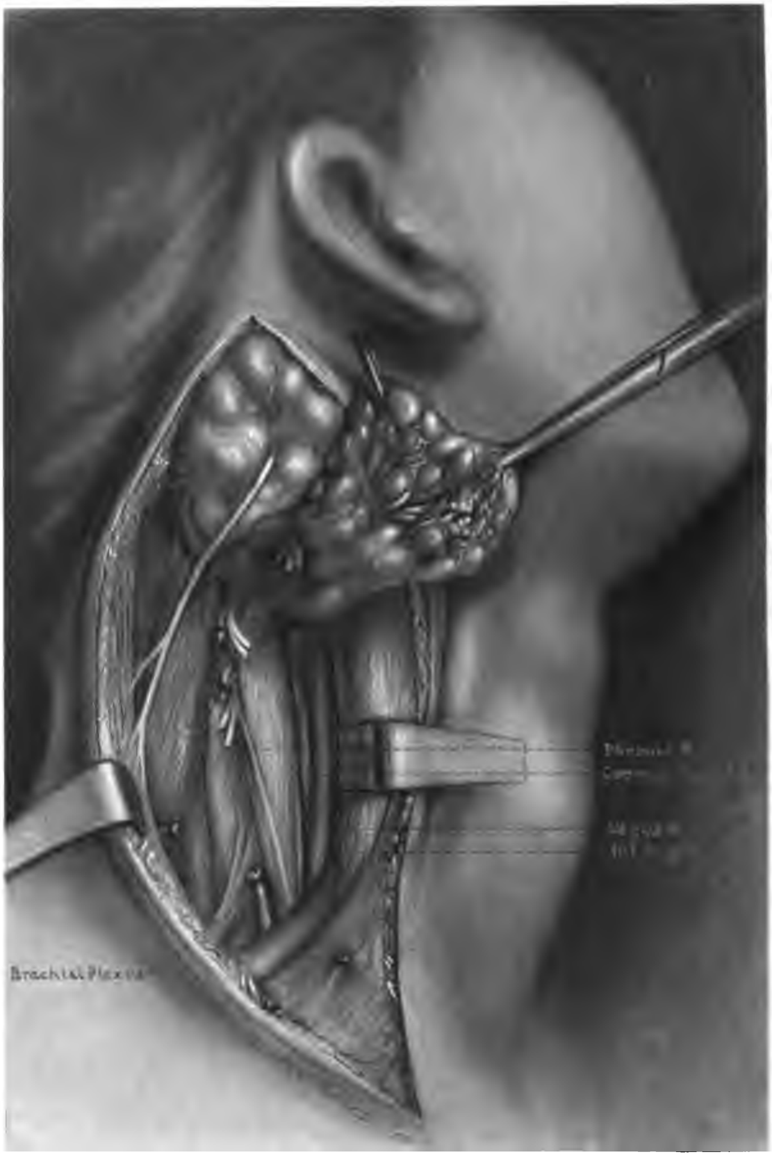


Fig. 280.—Showing fascia dissected from the lower angle. Internal jugular vein shown lying beneath the sternomastoid muscle. The phrenic nerve, lying on the scalenus anticus muscle and branching from the cervical plexus, is exposed.

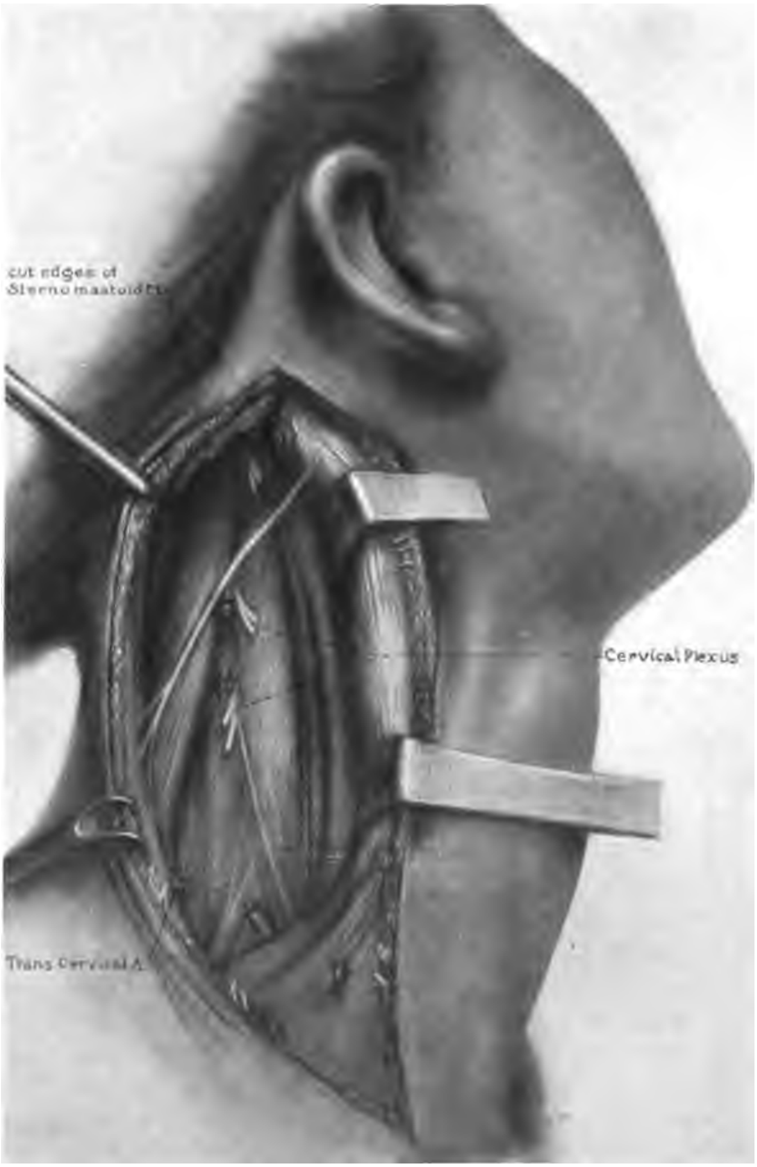


Fig. 281.—Shows dissection completed. The spinal accessory nerve passes diagonally across from the upper part of the sternomastoid muscle to the inner surface of the trapezius.

appear advisable to excise the glands; we have usually curetted and treated by swabbing with equal parts of tincture of iodin and carbolic acid. As soon as the sinus heals, a radical operation can safely be done if necessary.

Pulmonary invasion is not necessarily a contraindication to operation upon tuberculous glands of the neck. In ten instances we have operated upon patients who showed tubercle bacilli in the sputum. Nine of them were greatly improved and several of them were apparently cured by the operation. One developed an acute diffuse tuberculosis after the operation.

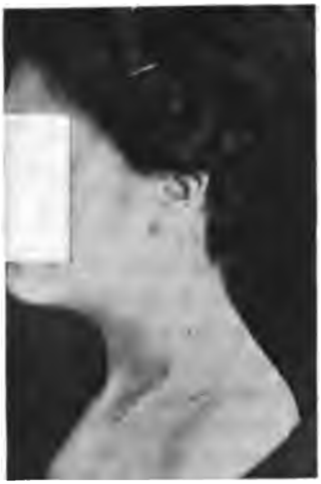


Fig. 282.—Photograph taken nine days after operation.

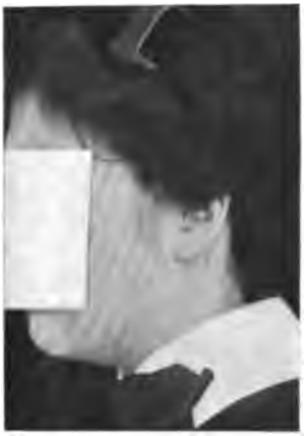


Fig. 283.—Photograph taken nine days after operation.

The chief objection to radical excision of glands of the neck is the resulting scar. Various incisions have been described and used. At one time the removal of the glands through many separate incisions was recommended. We have found that if we follow the natural creases in the neck and keep the incision as nearly as possible transverse, as suggested by Dowd, we can remove the gland-bearing fascia in one piece with very little scar or deformity resulting. The incision begins a little below and behind the mastoid process, extends straight down along the outer edge of the trapezius muscle, and then curves forward a little below the middle of the neck, and terminates at the juncture of the sternomastoid muscle and clavicle. Through this incision we are able to remove all of the deep descending chain, including the supraclavicular, the anterior, and the posterior groups. If the submaxillary and the submental groups are involved, a second incision running parallel to the lower jaw, two finger-breadths below the lower border, will expose the areas and avoid any important structures, *e. g.*, the lower branches of the seventh nerve. In order to prevent the formation of a wide, ugly scar, it is very essential that we turn back the platysma muscle and the skin in each flap. It is

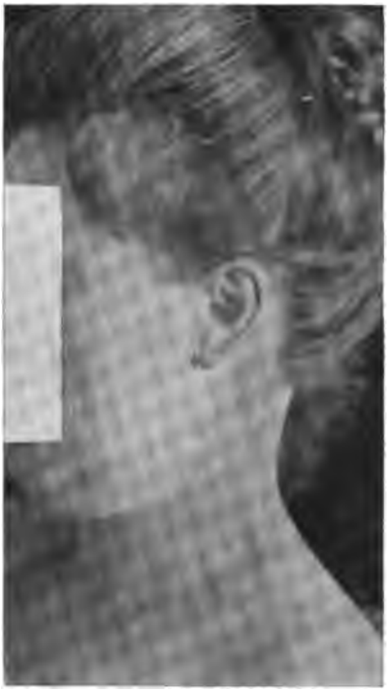


Fig. 284.—Photograph taken about two years after operation.

also important that the cut edges in the platysma muscle be sewed together before closing the skin. If these cut edges are allowed to retract, the separation will favor the division of the skin scar. In the past it has not been unusual to see a scar on the neck half an inch to one inch in width (Figs. 282 and 283).

It is our custom to drain these cases through a stab incision; this allows the large incision to heal primarily, and we believe this procedure to be a valuable aid in getting a good scar. The spinal accessory nerve is the only superficial structure that it is necessary to avoid in operating. In many cases the first gland to break down will be the one beneath the spinal accessory as it comes out of the sternomastoid muscle. In several instances we have known the nerve to be cut by simply lancing this broken-down gland. Usually

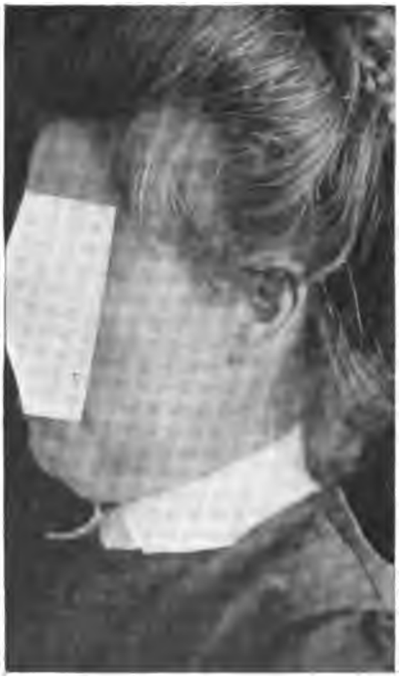


Fig. 285.—Photograph taken about two years after operation.

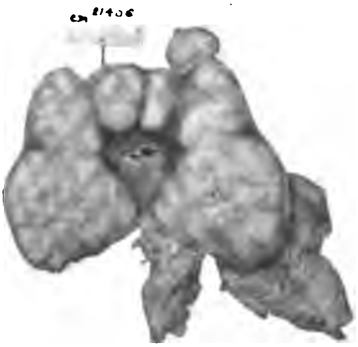
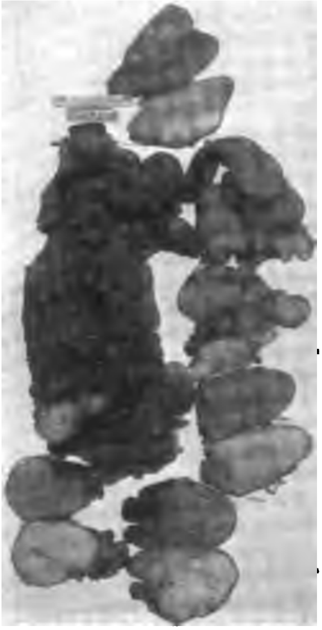


Fig. 286.



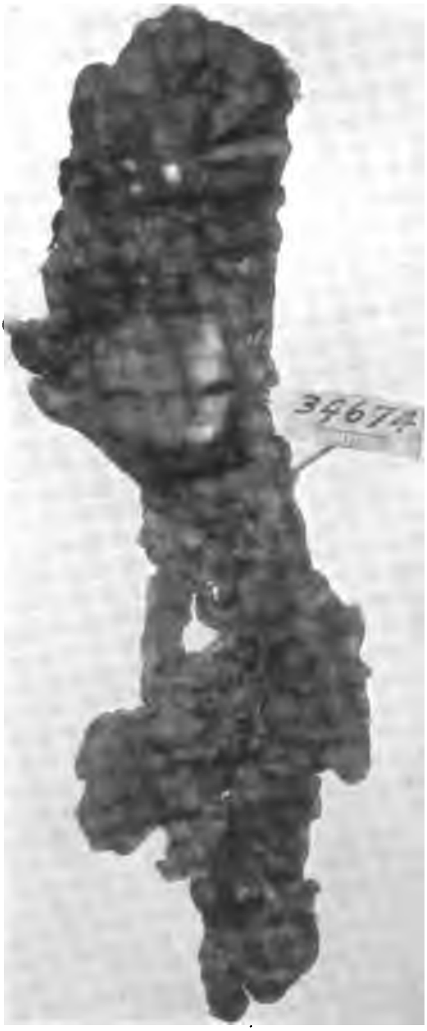


Fig. 287.

Fig. 288.

Figs. 286, 287, and 288.—Photographs of tuberculous glands after excision.

the nerve will be readily found coming out of the sternomastoid muscle one-half inch above the superficial sensory nerves, or it may be identified as it passes into the outer border of the trapezius at the top of the supraclavicular triangle (Fig. 279). If the nerve is accidentally cut, it can be sutured at once. It will unite and generally functionate well. If the ends of the nerve are allowed to retract, the deformity will cause a drooping shoulder and an atrophy of the trapezius muscle, which is unsightly and also hampers the use of the arm and shoulder to a considerable degree. We have injured and sutured this nerve on several occasions with no deformity resulting.

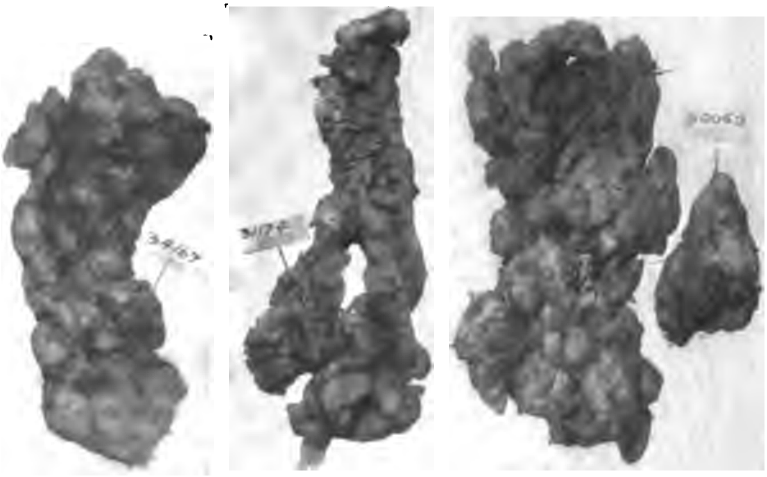


Fig. 289. Fig. 290. Fig. 291.

Figs. 289, 290, and 291.—Photographs of tuberculous glands after incision.

In a study of the anatomy of the lymphatics, we observe that tuberculosis invading these glands is likely to be a local process and not an indication of general infection. The entire chain of glands beginning at the subclavian vein and running back to the mastoid process can be removed in one piece without injuring a single important structure. If we consider the glands lying in the celluloadipose tissue (gland-bearing fascia) in the neck as a single organ, and treat the mass in a manner similar to that employed in tuberculosis of other organs, our results will be just as good and we will have done as much for the patient as though we had taken out a tuberculous kidney or removed a tuberculous cecum.

Some years ago it was customary to expect all tuberculous glands to recur. Lymphatic glands and vessels are anatomic structures, and if they are removed we believe are no more likely to recur than a finger is likely to regenerate after it has been amputated. Leaf is alone, I think, in believing that a lymphatic gland will redevelop between the two open ends of lymphatic vessels. In our own cases we are convinced that the glands which appeared after operation were glands which had not been removed.

During the past fifteen years we have performed 668 operations for complete excision of glands of the neck, 62 operations for partial excisions and curetting, and 24 excisions of tuberculous glands in the axilla in cases which also had tuberculous cervical glands. In all there were 649 patients operated upon on one side at a time. Of these, 19 have since died of pulmonary tuberculosis, and 9 have died of tuberculous lesions elsewhere. Ten of the patients had pulmonary tuberculosis at the time of operation.

In operating upon these cases it has been our effort to do a radical and thorough excision of the groups involved. Having made the incision from the mastoid to the clavicle, we reflect the skin and platysma well forward and backward. We do not cut the sternomastoid, except a few posterior fibers of its upper attachment on the mastoid process. The entire posterior border of this muscle is freed and the fascia dissected from it. The dissection is started at the lower angle underneath the clavicular attachment. The omohyoid pulley is exposed and this is the lowest point of the dissection. The glands are all left together in the fascia as much as possible (Fig. 280). In some cases the gland-bearing fascia can be dissected with gauze or the finger; at other times, especially if the *x*-ray has previously been employed, or if considerable resistance has developed, the dense fibrous tissue will necessitate sharp dissection. In freeing the edge of the sternomastoid muscle from below, up about half-way we come to the superficial cervical nerves, some of the branches of which turn over and across the muscle. These are purely sensory nerves and it is best to sever them and get a good exposure. A numbness which persists for some time occurs after cutting these nerves. One-half to one inch above the sensory nerves the spinal accessory emerges from the sternomastoid muscle and passes obliquely downward and outward superficially through the fascia to the trapezius. In carrying the fascia upward, we should, if possible, save the cervical fascia covering the brachial plexus. Traumatism of this plexus will frequently cause considerable suffering. The thoracic chyle duct as it enters the vein should be avoided. It is not uncommon to see the chyle duct on the right side. We have injured this duct during operation in about ten cases; in several instances it healed without causing trouble. In three cases the chyle drained profusely for several weeks and the patients became greatly emaciated. One of them lost 60 pounds; the duct eventually closed, however. All the patients made a good recovery. When the spinal accessory nerve is encountered, it should be dissected free from the fascia and held back while the fascia and glands are turned underneath it. As soon as the internal jugular vein is exposed, it is best partially to occlude its lumen in the lower angle by a gauze pack. This will keep the vein full and prevent sucking of air in case the vein is torn. On several occasions we have heard air sucking into the vein, but have seen no bad results from it. The dissection along the entire jugular vein is sometimes tedious, but we have sacrificed the vein in tuberculous cases in only two instances. Some care should be taken to avoid the phrenic nerve lying on the anterior scalenus muscle. The fascia will lead us directly to the styloid and mastoid. Lymphatic glands within the parotid should be shelled out in a manner that will not interfere in any way with the branches of the seventh nerve. Having completed the dissection, if caseous material has soiled the wound, we mop it out with tincture of iodin well diluted with water; or, as suggested by Von Eiselsberg, the entire wound may be mopped for an instant with boiling water. We have never seen any sort of an infection following the spilling of caseous material on the fasciæ (Fig. 281).

Drainage should be provided through a stab incision; we use, preferably, a small rubber tube split spirally. This drain is for the purpose of withdrawing serum and is removed in from twenty-four to forty-eight hours. The platysma muscle is carefully sutured with fine catgut and the skin edges are approximated by a subcuticular suture approximating as much of the cut of the skin as possible, giving the appearance of a ridge. In a few days this will smooth down to a line-scar (Figs. 284 and 285). A rather small, snugly fitting gauze dressing is used. The next day the patient is gotten up and encouraged to move the head freely to prevent any stiffening of the muscles. From this time general outdoor treatment is advised.

In our series of cases we have had no mortality due directly to the operation. One patient died a few weeks after operation of general tuberculosis, and a second died in about three months from diffuse sepsis (Figs. 286 to 291).

TABLE OF CASES

Total number of patients operated upon	649
Total number of operations	750
Average age	25
Number of cases under ten years of age	18
Complete excisions	668
Curetted	62
Both sides operated upon	94
Recurrence in region of former operation (8.6 per cent.)	56
Died of pulmonary tuberculosis (5 per cent.)	19
Mortality (1 died in four weeks, 1 in three months, 4 in one year, 5 in two years, 2 in three years, 2 in four years, 1 in five years, 2 in six years, 1 in eight years)	19
Died of tuberculous lesions other than pulmonary	9
Mortality (2 meningitis, 5 diffuse tuberculosis, 2 tuberculous peritonitis)	9
Died of other trouble	14
Number of patients with pulmonary tuberculosis at time of operation	10

OPEN TREATMENT OF FRACTURES*

By M. S. HENDERSON

Treatment of fractures is perhaps one of the oldest procedures employed in the practice of surgery. In pre-Listerian days and in days before the *x*-ray was known there was no advancement possible beyond the lines laid down during centuries of practice. Within the past twenty years a more scientific method of procedure has been advised, but up to the present day the older lines of treatment have been mainly adhered to. The subject has recently received special attention, and articles have appeared prominently in medical journals, some of them advocating the open treatment, and others of them denouncing the practice, claiming that the results obtained by the older methods are fully as good as, if not better than, the results obtained by using the new.

Arbuthnot Lane, of London, has been a staunch advocate of the open or operative treatment of recent fractures. He has steadily claimed, and proved, that results following the treatment of fractures, and particularly fractures of the long bones, have not been as good by the older method as the "general impression" would lead one to believe. Arbuthnot Lane refers to statistics, gathered in the early and middle part of the nineteenth century, which were quoted as evidence of the rarity of the non-union of fractures. These statistics were faulty, and it was evident that the cases had not been carefully traced, or the standards of total or partial disability were not the same as they are today: *e. g.*, Lonsdale, 1838, in "A Practical Treatise on Fractures," says that out of 4,000 fractures treated at the Middlesex Hospital only four or five cases refused to unite. It cannot be that in these days we are less successful in our treatment according to the old method. The frequency of non-union must be greater than the above statistics would indicate, as operations for non-union of old fractures are not a rarity, either in the clinics of this country or of those abroad.

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* Reprinted from the "Journal of the Minnesota State Medical Association and Northwestern Lancet," Oct. 1, 1910.

Aside from the question of non-union of fractures, a faulty union may hamper the patient to the extent of partially incapacitating him for work, and his wage-earning efficiency and general usefulness to the community will be correspondingly reduced. Clinton T. Dent, surgeon to the Metropolitan Police Force of London, quotes the end-results following fractures of the leg and thigh as follows: "Recovery from the point of view of the surgeon and that of the patient does not always coincide in date. The standard of efficiency is high in the police force, which is the class of men principally under consideration. The work demands fair activity; thus for two periods of two hours or for one tour of eight hours a man must be continuously on his legs day after day, though with frequent short spells of leave. Judged by this statement and desirous of keeping well within the mark, my estimate is that at least 30 per cent. fail to attain this standard after simple fracture of both bones of the leg. I can hardly recall a case of Pott's fracture or a Dupuytren's fracture where recovery has been complete enough to enable a man to resume police work."

In the "Annals of Surgery" for November, 1908, is a paper by Ashhurst and Newell on the "Treatment of Fractures of the Femur." The cases under consideration were treated in the Episcopal Hospital of Philadelphia. They were able to trace 61 cases treated by the conservative method, and of these 28 had a perfect functional result, 21 cases had no disability, although they limped, 8 had a marked impairment of function, and 4 were completely incapacitated. It is true that many of these accidents were to elderly individuals; nevertheless the results would lead one to make a gloomy prognosis. Their conclusions were that, as only 4 out of the 61 patients were completely incapacitated, the results were as good as could be expected. Looking at it from another point of view, in over half of the traced cases the result varied from merely the inconvenience of a limp to total disability. The outlook is certainly not very bright for individuals suffering with fracture of the femur if the conservation treatment is adhered to.

Speaking from a vast experience with recent fractures, Arbuthnot Lane says: "It may be that in some few cases of simple fracture non-union results from some cause which could not be obviated by proper treatment, but I have never come across one instance in which union would not have resulted if sufficient operative measures had been adopted, though a very large number have come under my observation." Lane shows by numerous *x*-ray cuts in his treatise on "Operative Treatment of Fractures" how his cases, with the aid of the metal splint, attain a perfect anatomic and functional result. By looking at the plates alone, one could have no doubt as to the correctness of his views. It is the general impression that he advocates the open treatment in all cases. This is not according to the statement made by him in 1905, in which he says: "For thirteen years I have made it my habitual practice to operate all cases of simple fracture of the long bones in which I was not able to obtain accurate apposition of fragments when the restoration of the bone to its normal form was of mechanical importance to the individual." This condition can always be readily determined by an *x*-ray plate before and after attempted reduction.

In France, Lucas-Championnière has long advocated his method of massage and early passive movement, but there is no reason why this method should lead to a better adjustment of the fragments. The irritation thus produced might possibly lead to more formation of callus and stronger though faulty union, often partially incapacitating an individual and so preventing him from again attaining wage-earning efficiency.

Special types of fractures cannot be taken up in this paper, as, for example, fractures of the tibia and the femur. The fracture in these bones is more often spiral or oblique than transverse, and the apposition of the surfaces is more difficult. It is often impossible to restore the axes of these fragments by the conservative method, and union with axes of these fragments not in line will mean that the weight transmitted through this faulty union will cause annoyance of a varying severity. It may be the cause of an arthritis and mechanical change in the joint surfaces. The older the individual, the more liable is this to occur. It has been shown that in children nature comes to the assistance by gradually (covering a period of three or four years) completely replacing the old deformed shaft with a new one, transferring the force transmitted naturally by the bone in one axis instead of two, which must be done if there is an angulation of the shaft.

Perhaps one of the commonest forms of fractures encountered is the Pott's, or somewhat rarer is the Dupuytren's fracture. The break is produced by an eversion of the foot, and the result may be merely a fracture of the fibula and a tearing of the internal lateral ligament, or the internal malleolus of the tibia may be broken off. The deformity produced varies in degree, and displacement backward may occur, making the reduction decidedly difficult. The result here is important, and far too often the treatment by the conservative method yields a deformed ankle, which is painful to the patient. Obstinate flat-foot may follow, due to the tibialis posticus tendon being displaced, so depriving the arch of its normal support. This tendon can be replaced in its normal position and the bone fragments accurately coapted only by the open treatment. As has been previously mentioned, Dent stated that he could hardly recall that a patient sustaining a Pott's or Dupuytren's fracture had ever been able to resume his duties on the London police force. Because of such probable disability, how important it is that we should resort to some method which will restore to our patients a limb that will functionate normally.

In advocating operative treatment of simple fractures, one should consider that existing circumstances and surroundings must determine the procedure to be followed. Strict asepsis is at all times necessary. Therefore operative procedures on fractures should be done only when we are assured of surgical technic which is of the best and safest. The general feeling is that simple fractures had best be treated by fixation according to the old method rather than by the open method when there is a chance for infection. A tedious and longer convalescence will certainly follow if the wound becomes infected. Bruised tissues are much more susceptible to infection than healthy ones, and perhaps even more so than the peritoneum is. Compound fractures, however, would perhaps best be operated upon, as they are of a type which will be slower in healing, though they generally unite, and will need more careful and accurate fixation.

Briefly, the advantages to be gained by the operative treatment of fractures are: (1) anatomic restoration of parts, (2) a restoration of function to the normal, (3) a shorter convalescence and less pain.

Secondary to the surgical principle involved is the technic to be employed. Metal splints are perhaps the best means of holding the bony fragments together. Silver wire, in our hands at least, has not been very satisfactory. An ordinary steel plate, using ordinary steel screws, is sufficient. The splint held by two screws on each side of the line of fracture insures the best fixation. Oftentimes long screws are sufficient to hold the fragments in position. Different-sized drills are used for boring holes for the screws. Certain cases, such as fracture of the olecranon process of the ulna or the patella, can be competently held by chromic catgut, placing the limb in a plaster cast during convalescence. The least possible handling or bruising of the soft parts is to be desired.

In the clinic at St. Mary's Hospital the cases of fracture treated by the open method have been mostly old non-united fractures and fractures about the joint. The number of cases of acute traumatic surgery treated by us is not so great as the number treated by men in industrial centers, and we must accordingly learn from them and apply their teaching and their experience.

If after an attempted reduction of a recent fracture we do not get a perfectly accurate approximation of the fragments, as shown by the *x*-ray, so that there will be practically no disturbance to the longitudinal axis of the shaft, we resort to operation or open treatment, thereby gaining the anatomic and functional result to be desired.

It is commonly urged against the method under discussion that the metal splints, etc., applied, are foreign bodies, usually giving annoyance and having to be removed. This has not been so in our experience. The large majority of cases have been non-united fractures of long standing, most of them over a year and many of them two and three years. In the clean cases the splints have not given any trouble, and in fact in some cases in which an ivory bone-plug has been introduced in the medullary cavity to set up a chronic irritation and hasten the formation of callus, the ivory plug has healed in, and the patient has had a perfectly functionating limb.

We have used the metal bone-splint in twenty-seven cases, and have obtained reports from sixteen of them. In only two of the cases has it been necessary to remove the splint. Both of these patients were operated upon for old compound non-united fracture.

TECHNIC

SKIN FLAPS AND SKIN GRAFTING*

By EDWARD STARR JUDD

I wish to describe, in this paper, a method of saving skin flaps in injury cases, and also a method of skin grafting which has been employed in the Mayo clinic for a number of years.

First, in the immediate treatment of extensive crushing injuries of the extremities, the patient's general condition as regards shock and hemorrhage should be considered. Second, the amount of permanent disability and the length of time he is to be absolutely disabled.

We see cases frequently where the extremity has been entirely severed and large flaps of skin are hanging to the edges of the wound, or the injury has simply lacerated the soft tissues of the side of the extremity—perhaps the fingers or toes. We know that if we sew these loose and crushed skin flaps back into place they will not live, and we also know that if we remove them it may be weeks or months before we will be able to entirely cover the granulating surface with skin. If the flaps are replaced, in all probability at the end of twenty-four hours they will be purple in color, and somewhat swollen and edematous. In forty-eight hours they will be blue, then they will become black, a line of demarcation forms and they die.

The gradually increasing dark color in the flaps must mean that more blood is being held in them and cannot escape. The dark blood gives the dark color to the skin. This condition continues until the flaps are badly swollen and congested. The arterial blood is eventually all shut out for want of space; the blood already there cannot escape and the tissues become gangrenous and drop off, *i. e.*, they *die black* from an over-supply of blood.

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* Read at third annual meeting Surgical Association Chicago and Northwestern Railway, Chicago, Jan. 6, 7, 1910. (Reprinted from the "Railway Surgical Journal," Aug., 1910.)

Thiersch, by his method of skin grafting, has shown that thin flaps of epithelium can be shaved from the skin and made to grow upon fresh or granulating surfaces. These grafts take up circulation from surrounding tissues upon which they live.

In consideration of the above facts, this point occurred to us: To convert these flaps practically into Thiersch grafts, retaining the pedicle on which they are suspended, for support and to keep the flap in position. The plan has worked very well, and we employ it not only in traumatic cases, but in any case where we want to fill in a space by transferring or swinging flaps. The procedure has been most useful in covering large areas after operation for cancers of the breast.

In traumatic cases it is, of course, essential to have the fresh surface and the flaps thoroughly cleaned. Trim the fat and fascia from the inner surface, cut the flap into long narrow strips, and place these strips on the fresh surface much as you would place ordinary grafts. Each strip will get plenty of circulation from its pedicle and the surrounding tissues to keep it alive, yet it will not fill up with blood because, in cutting the flap into small pieces, we will open the tissues and provide a temporary exit for the excess of blood. In this manner we might often have saved large pieces of skin which some years ago we sacrificed, believing it impossible to save them. The method is very useful in comparatively slight crushing injuries of the fingers and toes. It sometimes enables us, not only to reduce the disability period, but to save a part of the extremity.

In recent years considerable work has been done with the so-called "whole thickness grafts." Frequently the whole thickness of the skin can be grafted to the sole of the foot or the palm of the hand to advantage, where it is essential there should be no contraction or over-sensitiveness. This graft may be applied to the face, especially about the nose. It has been our experience that it is much better to transport these grafts, leaving the pedicle attached until the flap heals in. In several instances we have turned a flap from the thigh or abdomen to the palm of the hand, fixing the hand for two weeks to the area from which the graft was taken; when the flap which is sutured into the palm is healed, the pedicle may be cut and the flap fastened into its proper position. The sole of a foot can be made from the thigh or calf of the opposite leg.

If a good-sized flap is wanted for plastic work about the face, a satisfactory method of transferring it is the one described by Finney. He first raises the proper sized flap from the abdomen, leaving the pedicle attached, and sutures the free edge into an incision made in the forearm. This is kept in place for two weeks and then cut free from the abdomen. The forearm is then bound to the head and the free edge of the flap sutured into a suitable place on the face. The arm is kept in this position two weeks, then the flap is cut free from the forearm and sutured into position on the face. We employed this method in one case—a boy upon whom several plastic operations had been done for a bad scar about the face and neck following a burn. The mucous membrane of the lip was practically attached to the lower border of the jaw. We transported a flap large enough to make an entire lower lip and part of the cheeks, with very satisfactory results. Two weeks will usually suffice for a flap to heal into a fresh cut.

A unique method of determining when the circulation in the flap is sufficient is that described by Sherman. Put a light constrictor rubber bandage around the extremity and observe the appearance and disappearance of congestion in the flap as compared with the congestion in the extremity.

Two instances are reported of transporting flaps from one individual to another, but they were not successful.

Davis has classified Thiersch grafts as follows: (1) *Autodermic*—where the graft is obtained from the same individual; (2) *isodermic*—where the graft is obtained from another individual of the same species; (3) *zoödermic*—where the graft is obtained from a lower species.

Davis reports 19 successful grafts, 16 partially successful, and 5 failures in 40 cases in which the isodermic grafts were used. He believes the method to be more satisfactory than is generally credited by surgeons. However, grafting from one individual to another is not now as frequently employed as formerly.

We seldom find it necessary to use an anesthetic in cutting the grafts. They should be cut thin, and by preference we take them from the outer side of the right thigh, where the sensation is not so acute and there is the least danger of phlebitis. The area from which the skin is to be taken is prepared in the manner we prepare any surface for operation. This consists of a thorough scrubbing with gauze, soap and water, shaving off the hair if necessary. The surface is then sponged for thirty seconds with Harrington's solution and washed off with alcohol, which is left until mostly evaporated, then washed off with water and the surface dried. The grafts cut better if the surface is absolutely dry. On striking the skin with the palm of the hand quite forcibly, a numbness or local anesthesia will be produced. The soft tissues are held firm with the edge of the hand of an assistant and the free hand of the operator. We prefer to use a razor with a flat blade, and cut the flaps thin. If the graft is small, it can be straightened out on the surface of the razor, but we prefer to carry it to a large spatula, straighten it out, and transfer it from there to the area to be grafted. If a fresh wound, the area to be grafted must be absolutely dry; if a granulating surface, the granulations should be firm. If they are exuberant, it is better to trim them down and apply a weak iodin dressing for one or two days before grafting. The granulating surface should be as nearly dry as possible. When applied, the grafts should overlap each other and should also overlap a short distance on the skin edge. In case large grafts are being used, several small openings are cut in each of them to allow for air-bubbles and to prevent any moisture floating the graft away from the granulations.

There is a great diversity of opinion regarding the dressings and after-care of these wounds. We have found the most satisfactory dressing to the area from which the grafts are removed to be several layers of plain dry gauze bound firmly to the extremity with adhesive plaster. This is let alone until it loosens and frees itself, which will usually occur in from eight to ten days; then it is removed and another dressing is reapplied. We have tried different kinds of dressings for the grafted surfaces; such as foil and rubber tissue, but nothing has succeeded as well as dressing the wounds absolutely dry with forty to fifty layers of plain dry gauze, all applied at once. The gauze pad should be a little larger than the grafted area and should be held firmly in position during the placing of many pieces of adhesive plaster to hold it so that it cannot move. This dressing is covered with one of cotton and bandage, and the entire dressing is left in place from eight to ten days, when it is removed with care not to disturb the grafts. If there is considerable oozing, the outside dressing may be changed often. The first impression at times will be that the grafts did not take, but at the second dressing the area will be almost entirely covered. For this reason it is important that care be used during the first three or four dressings, especially if there is a question as to whether or not the grafts have taken.

By using the above technic in the application of grafts and in the dressing of wounds, we practically never see a case in which the grafts do not partially take, and seldom one in which they do not all take.

GENERAL PAPERS

THE HOSPITAL LABORATORY, WITH SPECIAL REFERENCE TO DIAGNOSIS IN SURGICAL CASES*

By LOUIS B. WILSON

The last fifteen years have seen great progress made in the construction and equipment of hospitals in this country. Along with this, in teaching institutions, there has been equal progress in the development of laboratory facilities for the study of pathology and bacteriology. Many of the newer hospitals, fortunately in close affinity with medical schools, have been able to take advantage of the laboratory facilities offered by the schools and to use them for their own purposes in exchange for clinical and pathologic material. There remain hundreds of hospitals on this continent, however, with very meager equipment and inadequate service for the diagnosis of the diseases of the patients within their doors. It is, unfortunately, often assumed that the chief function of a pathologic laboratory is for the dilettante study of problems somewhat remotely connected with the welfare of the individual patients, and consequently many hospital boards have regarded laboratory equipment as a luxury rather than as a necessity. Aside from the fifteen or twenty great hospitals in America with proper laboratory equipment, there are, perhaps, twice as many which have some service in the examination of urine, blood, sputum, stomach contents, etc.

The equipment for a clinical laboratory of this class is quite inexpensive, involving the purchase of a microscope, centrifuge, blood-counting apparatus, hemoglobinometer, hand spectroscope, and glassware, at an expense of but two or three hundred dollars. It is readily conceded that the examination of urine, blood, sputum, stomach-contents, feces, etc., is of primary importance in the diagnosis of almost every medical case, while in surgical diagnosis they are no less so. To place a patient on the operating table, except in dire emergency, without a urine examination is almost malpractice. The hemoglobin content and, in acute anemias, the differential leukocyte determination are no less important. While in many cases of gastric disorders examination of stomach-contents gives us no diacritical data, yet in others it is of so much importance that we cannot afford to omit it. It would seem, then, but a fair assumption that every hospital, no matter how small, should be provided with a laboratory equipped for at least these examinations.

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* Read before the Canadian Medical Association, Aug., 1909. (Reprinted from "The St. Paul Med. Jour.," May, 1910.)

In the last ten years provincial, state, and city board of health laboratories have been so well developed that the bacteriologic service rendered by them has become very efficient. The experience and skill necessary for high-class bacteriologic work with diphtheria, typhoid fever, etc., can seldom be obtained or maintained by the amount of material furnished in a small hospital. Certainly every hospital should have its incubator, and a small supply of media for bacteriologic diagnosis; but where the number of cases of diphtheria or typhoid fever determination falls under fifty a year, it is doubtful whether the service were not better rendered through a large central board of health laboratory, if access can be had to such. Those questions of bacteriologic diagnosis which are determined by direct cover-slip preparations, gonococcus, tuberculosis, etc., can be readily settled with the simplest equipment in the hospital laboratory.

The *x*-ray service of most hospitals is associated with therapeutics. In surgical clinics, however, there can be no question of its great importance in giving diagnostic data. Where *x*-ray treatments are regularly given, the diagnostic service should be developed for fractures, foreign bodies, kidney stones, etc.

Of the various branches of laboratory service, that which is perhaps in closest relation to surgery is tissue diagnosis. This feature is, unfortunately, frequently neglected, and this neglect in the past has been due largely to a feeling that tissue diagnosis necessarily meant prolonged preparation of the specimen before the study could be of any value. It is not an uncommon thing for surgeons to send their operative specimens to distant laboratories and then wait for the slow returns from tissues which have been carried through the various prolonged processes of preparation for the microscope. In many other hospitals, even where there is a proper laboratory equipment for this work, all tissues are fixed, hardened, embedded, cut, stained, and cleared before they are examined. It not infrequently happens in both of these instances that the patient is dead or well before any diagnosis is rendered. Such a course materially lessens the interest of both surgeon and pathologist in the pathologic aspects of the case, and renders the diagnosis almost valueless to the patient. From the surgeon's standpoint the ideal examination of tissue should be completed before the wound is closed. This may be done at present by freezing and staining sections of the fresh tissue with polychrome methylene-blue. So far as the writer is aware, this is the only dyestuff which stains intensely and with good differentiation chromatin and cytoplasm in contrasted colors at the same time, while the tissue is still alive. While experimenting with a number of stains and methods four or five years ago, it occurred to me, in view of my experience with Bethe's method of intra-vitam staining with medically pure methylene-blue, and with the use of Unna's polychrome methylene-blue in staining blood in thin paraffin sections, to try the latter with living tissue in frozen sections. The results were surprisingly good, and we have used the stain now for over four years, and have come so to rely upon it in the differentiation, particularly of epitheliomata of all sorts from infectious granulomata, that we could not get along without it.* To the surgeon the most frequently recurring questions of importance in tissue diagnosis are: Is the tumor cancer? Is it sarcoma? Is it tuberculosis or other infection? When the evidence is within the tissue submitted, these questions may be positively answered in almost every instance within five minutes of the receipt of the specimen in the laboratory.

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* For those not familiar with the method published in "The Journal of the American Medical Association," Dec. 2, 1905, it is herewith reproduced: (1) Fresh tissue, the cells of which must be still alive (*i. e.*, if not kept in the ice-chest, not more than two hours out of the body) in bits not more than 2 x 10 x 10 mm., is frozen in dextrin solution on a good microtome and cut in sections 5 to 15 microns thick; (2) remove the sections from the knife with the tip of the finger and allow them to thaw thereon, thus avoiding later development of air-bubbles; (3) unroll the sections with camel's-hair brush in 1 per cent. NaCl solution. (4) stain ten to twenty

The tissue is frozen, sectioned, spread out in salt solution, stained ten to twenty seconds in polychrome methylene-blue, washed again in salt solution momentarily, and mounted from Bruns' glucose media. Good photomicrographs may be made directly from slides prepared in this manner. Surely if a section is good enough to permit its being photographed, it is good enough to permit of the determination of the character and arrangement of its cells optically.

The laboratory for histologic diagnosis should be next door to the operating room. Objection to this is frequently made on the plea that the laboratory is too dirty to have on the operating room floor. Such objection is, however, wholly groundless. If the laboratory is properly furnished with metal and glass tables, it can be kept quite as clean as the operating room and with little trouble. When we consider the number of errors that are constantly being made in the diagnosis of tumors of the face, lips, mouth, stomach, gall-bladder, intestine, breast, uterus, etc., where only clinical and gross examinations are made, and when we consider also the very serious nature of such errors, involving,

seconds in Unna's polychrome methylene-blue, Grubler's; (5) wash out momentarily in 1 per cent. NaCl solution; (6) mount in Bruns' glucose medium (see Lee's Vade Mecum). The Spencer automatic microtome with CO_2 attachment and vulcanite insulating plate, gives excellent sections. Handle the sections from first salt solution through to the slide with a small glass rod-lifter. Keep the sections constantly moving while in the stain. The smaller the stain cup, the more readily tissue may be found in it if dropped from the lifter. If fluids for unstained sections are in clear glass over a black background, and those for stained sections are in white porcelain or clear glass over a white background, the work will be much facilitated. The various tissue elements are sharply contrasted in red, purple, and dark blue. Even mitotic figures, where present, are many times beautifully shown. The sections, of course, fade as they die and decompose. Formaldehyd-fixed material, first thoroughly washed in tap-water, may be treated in exactly the same manner as fresh tissue. The color differentiation is materially different, but the process is of great convenience for the rapid examination of a great number of blocks from a given specimen.

as they often do, the life of the patient, the importance of the histologic examination cannot well be overestimated. Indeed, it would seem incumbent upon every hospital which maintains an operating room to maintain also a laboratory for pathologic tissue diagnosis.

The above named laboratories are those which are necessary for diagnostic work. There should be in every hospital, however, some place for scientific study of the material furnished by the institution. Frequently this consists only of some cramped basement room, where a postmortem may be made under difficulties, and a closet for specimen jars. The autopsy should yield us more than the cause of death, and to do this it must be made with equipment for preparation for research. The museum must be sufficiently capacious to permit of the preparation, classification, and arrangement of specimens, otherwise they soon become worse than valueless. Many hospitals fail in their duty to science in the procuring of autopsies through a false sensitiveness in asking permission to make postmortems. It is possible to make postmortems so popular that the friends feel they are not getting the full worth of their money if an autopsy is not performed on the body of every patient that dies.

But the research laboratories of the hospital should not stop with the equipment of a morgue and museum. There must be rooms for the careful preparation of permanent sections for fine cell study; rooms for the photographing of patients, the photographing of gross specimens, and the photographing of microscopic sections. The graphic-record of pathologic specimens, either by photographs or drawings, has been much neglected. Drawings are expensive and inaccurate. Photographs may now be made—either single or, much better, stereoscopic—which convey more information than pages of manuscript.

Few hospitals can furnish facilities for animal experimentation, but where possible this should not be neglected. Finally, there should be provided laboratories for the workers to correlate disease data. I realize that this plan contemplates something more than that of the architect who so primly tells you that he has provided in his hospital plans "a place for the doctor to put a microscope," but the diagnostic service is of so great importance to the patient under immediate consideration, and the research service of so great importance to the future patient, that there should be no hesitation in the proper equipment for these purposes.

The last but most important item in the equipment is the pathologist. Some years ago, when I was seeking an assistant, the head of one of our largest laboratories, to whom I had applied for a possible candidate, wrote me that "pathologists were as scarce as cooks," and the demand has increased since then much more rapidly than the supply. I am inclined to think that the pathologist-interne, under the immediate direction of the professor of pathology in the nearest medical school, is the simplest, though not the best, solution of the problem. The practice of some hospitals of relying solely upon the diagnosis made by an undirected medical student is most reprehensible. Surgeons who would not trust such an untrained person to diagnose the simplest disease clinically, will accept without question a diagnosis from the same individual involving the most difficult tissue differentiation of sarcoma and syphilis. The embryo pathologist must be trained, but he should not be trained at the expense of patients and science. Where the number of patients in a hospital, either general or surgical, is large enough to require the services of two men, at least one of them should be the best that can possibly be paid for, and his should be a permanent engagement. It is hoped that the increased emoluments of the pathologist which are now obtaining will have considerable to do in developing an increased interest in the subject, and providing a greater number of men who will remain permanently in laboratory work.

THE PROPHYLAXIS OF CANCER*

By CHARLES H. MAYO

Among the great problems which confront the world to-day is that of cancer. The question of tuberculosis has been practically answered. The bacillus is known, as well as its modes of entrance to the body, its varying methods of attack, and the causes of death from the disease. Up to a few years ago what the public learned of tuberculosis was through the advertising of interested dealers of patent medicines, promoters of health resorts, and the exaggerated statements of irregular practitioners. To-day, with what may be called a world movement, tuberculosis is gradually being controlled and the percentage of deaths is yearly being lessened.

In view of the wonderful progress made in the prevention, care, and curability of tuberculosis which has developed in the short time since the public was first taken into the work as assistants, is it not time that we should more generally diffuse what knowledge we have of cancer?

This world-wide disease is not confined to any certain people, but occurs among all races of mankind, and, indeed, is found throughout the vertebrate kingdom. Fish often have goiter, and in certain waters cancer seems to develop from these secondary changes in the thyroid. The disease also occurs in birds. In over a thousand instances primary cancer has been found in mice and thousands of cancers have been grown by inoculation (Bashford). Domesticated animals are somewhat more susceptible to it than animals in the wild state. This fact is explained as due to their longer life, the disease being more common in the relatively aged in both man and animal. While cancer is said to be uncommon in some countries, in Japan, for instance, there are 25,000 deaths a year from the disease in that country. In England it is estimated that, of individuals over thirty-five years of age, one out of every eight women and one out of every eleven men die of cancer—a greater death-rate for age-period than from tuberculosis. We are not far behind in this country, with 80,000 cases constantly in progress and over 40,000 deaths each year from the disease.

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* Chairman's Address before the Section on Surgery of the American Medical Association, at the Sixty-first Annual Session, at St. Louis, June, 1910. (Reprinted from the "Jour. of Am. Med. Assoc.," Nov. 5, 1910, vol. lv, pp. 1605–1607.)

It is undoubtedly true that the public is at present looking more anxiously for a specific or cure than for prevention of cancer, but it is in the line of prevention that the medical profession has assumed its present position of importance in the world. Practically all of the acute diseases with which the population of the earth is afflicted are due to bacterial infection. It follows naturally, therefore, that the medical profession should search diligently for the germ of cancer, that an antagonistic remedy may be developed for its cure.

While it would be extremely interesting and useful to discover the parasitic origin, if such it be, of cancer, it is not vital. It requires but little judgment to decide that to prevent disease is better than to cure it. To prevent a case of diphtheria should be greater cause for elation than greatly to reduce the mortality by the use of antitoxin. The use of antibodies or serums as cures when the disease has been permitted to develop, and their use as vaccines for the prevention of disease, should by no means be discredited. It has been by such prevention and control of disease in children, and the reduction of mortality in adults, that the length of human life has been increased, and more people now than formerly reach a cancerous but not a proportionate old age. This fact, together with better diagnostic facilities and more carefully collected vital statistics, makes it appear that cancer is on the increase. The sooner this subject becomes one of general discussion, as tuberculosis has been in the various scientific meetings and in literature, the sooner may the adult hope to reach old age.

What is cancer? I shall not enter into a special description of cancer and its varieties beyond quoting briefly from L. S. Pilcher, who described the condition as follows: "It is in the lawless proliferation of preëxisting epithelial cells in luxuriant, irregularly arranged masses that invade underlying and surrounding tissues, permeating, destroying them, and finally themselves attaining a mass which can no longer be adequately nourished by an accessible blood-supply, and which itself then falls into central decay, while at the periphery the process still goes on, that cancer consists."

We must consider the irritation of groups of epithelial cells as the primary origin, and that such an arrangement occurred as a prenatal inclusion (this is questioned), or postnatally as a result of some mechanical or inflammatory condition. There is then a cell proliferation which becomes cancerous only when there is infiltration of the tissues.

From all the information which has been presented on the subject it is evident that there often exists a precancerous condition. The unproved type, that of prenatal displacement, we are unable to recognize. The postnatal type we recognize at least in the presence of tumors of a temporary, benign character in their more regular and uniform arrangement of structure and cells, such as warts of the skin, papillomata of the bladder, and fibromata of the breast, as well as cell inclusions which occur in the scars of inflammations, or burns and the results of long-continued local irritation to tissues. These growths resemble the embryologic development of cells merely in the power of cell multiplication and in the continuance of type in the metastasis and transplantation of the growth. Youth, because of the vigorous growth of the cells, is less subject to cancer, yet more susceptible to poisons, but the active lymphatics in youth cause rapid dissemination of disease when it occurs.

Bashford shows that, while no race of mankind is exempt from cancer, the predilection for the disease in certain countries is more from local irritation than from the peculiarities of climate, soil, and diet. I shall mention only a few well-known sources of irritation as a cause of special cancer. For instance, carcinoma of the mouth is rare in European women but common in men, yet in Ceylon and India women suffer greatly from cancer of the mouth because of the chewing of betel-nuts and holding the plug in the mouth. In this country leukoplakia carcinoma is found mostly among those who use tobacco. Cancer of the skin of the abdomen, a rare condition, is common in natives of Kashmir, who wear abdominal charcoal heaters next to the skin. Lip or pipe cancer is an example of radiant actinic irritation, and there are numerous tumors from chemical and infective sources. Chimney-sweep cancer and innumerable other special forms are seen. It has been shown also that it may occur in a circumscribed area, and that any epithelial lining or covering may become cancerous. Why this is not still more common following chronic irritation or, if due to a special germ or parasite, why it does not occur after acute simple injuries, it is impossible to say.

It is generally supposed that carcinomata often develop from severe single injuries, but there is no evidence that single injury does other than call attention for the first time to a preëxisting tumor or hasten the growth in early or dormant malignancy. It is an apparent fact that in classifying the causes which may render precancerous conditions active we should include nerve-cell fatigue, such as is seen in the modern business world. The organs of convenience, *e. g.*, stomach, bladder, and large bowel, which were added late to primitive life, have poor cell resistance and are prone to cancer degeneration.

Cancers of the stomach, bladder, and large bowel undoubtedly often result from chronic local irritation. The tumor may often originate about the base of the appendix and in the wall of the cecum. It has been found by MacCarty, in a study by serial section of over 5,000 appendices which had been removed for so-called chronic subacute appendicitis, that 0.5 per cent. of them were carcinomatous, although the external appearance of these appendices did not always indicate such a condition. The diagnosis was made at operation in only 23 per cent. of the cases. It has been shown that diverticulum of the large bowel is sometimes the cause of cancer, and in such cases it is only in finding comparatively early growths which have not destroyed the diverticulum that the original location of the change can be shown. Therefore, in advising the early removal of chronic, inflamed appendices, we are avoiding the possibility of the development of a few cases of unrecognized cancer, not to mention the possibility of its development in some of the appendices which are removed in a precancerous condition.

Just at this time ulcers of the stomach seem to have taken a leading position as the cause of cancer development. It is not hard to understand how cell groups may become isolated by connective-tissue development as a result of erosion or ulceration. This condition is becoming more and more commonly recognized, and it is estimated that a large percentage of the cases of cancer of the stomach have developed on ulcer. The trend of popular treatment in gastric surgery is to recognize the cancerous tendency of ulcers and excise them in their precancerous condition, reserving gastrojejunostomy for the cases of obstructed pylorus from closure or probable stenosis following excision of the ulcer. The question presents itself as to whether the supposed repeated medical healing of ulcers relieves the tendency to cancer.

Papillomata of the bladder are often found in the benign stage, yet we know that they develop cancer, and they should, therefore, be thoroughly removed as a precancerous condition.

It has been noted that the prostate gland is very frequently subject to hypertrophy and hyperplasia, yet operation for its removal has been advised only when the distress and necessity become very great. Our present knowledge of the condition shows a high percentage of cancerous changes in the gland, which should be taken into consideration in deciding the advisability of operation before the proliferation of tissue becomes an infiltration, and some relief an absolute necessity. The mortality following operation in this early stage is low in comparison with that resulting from deaths of patients with symptoms who have not been operated on, to say nothing of the suffering which will have been avoided. Operation, however, is not advised merely because there is hypertrophy, which is common, but to avoid the changes incident to chronic irritation when it exists.

Patients with thyroid tumors who require operation prove that chronic irritation of an adenoma may cause carcinoma in about one in twenty-five or thirty cases. A rapidly growing hard goiter should be looked on as a menace and early operation advised.

In a consideration of the irritative effects of the tumors of the body of the uterus, in which fibroids are common, we find $1\frac{1}{3}$ per cent. to be sarcomatous and 2.5 per cent. carcinomatous; yet the fibroid itself would be capable only of sarcomatous malignant change. In 1,000 hysterectomies for fibroids in women over fifty years of age, Sutton found that 10 per cent. of the tumors were cancerous. The condition will be found fifteen times in the cervix to once in the body of the uterus, yet in the cervix it is associated with fibroids in only $\frac{1}{3}$ per cent. Of the cases of cancer of the body of the uterus 40 per cent. are associated with fibroids, that is, over one hundred times more frequently than in cervical cancer. The first stage in such cases is adenomatous proliferation of the endometrium; the second, lawless cell-growth and invasion, or cancer. Fibroid of the uterus, while a fairly common condition, may often not be realized by the patient. Operation should not be advised in all cases, but in those which are giving symptoms; myomectomy in the young and hysterectomy in the older individual being the methods of choice. Chronic erosions are probably a greater menace than is commonly supposed, and they should receive attention.

A few years ago a tumor of the breast of a woman thirty-five or more years of age, which was not of infective origin, was considered malignant in proportion of four to one, and it seemed probable that nearly one-half of the tumors which were considered benign at the time of operation eventually became malignant. In the last ten years the increasing knowledge of the public, which has led to earlier operation, has reduced the proportion of probable malignancy at least 10 per cent. Tumors of the breast, not themselves malignant, may create a change in the adjacent breast tissue by chronic irritation, or they may change within their own structure. Well-collected statistics show that the results following operations for cancer of the breast indicate that 80 per cent. of the patients remaining well three years were operated on within six months of the development of the tumor, and about an equal number, who had no palpable glands in the axilla at the time of operation, remained well. It is obvious that a patient should not be obliged to have the growth of a tumor watched for marked evidences of malignant change, a delay which might reduce the chances from the best average of cure; that is, about 50 per cent. for three years, to a possible 20 per cent. cure, or much less.

Considering that the mammary gland is very prone to cancer, are we justified in hesitating to advise early removal for examination of supposed simple tumors as freely as in those which are considered malignant? Physicians should not assume the responsibility of delay, but should inform patients that in retaining this source of chronic irritation they must do it at their own risk and responsibility. From a careful observation of the operative cure of cancer of the breast it appears quite probable that an early operation, even though incomplete so far as the removal of muscle, axillary lymphatics, fat, and fascia is concerned, will still give better results than the most radical operation which is done late. I by no means wish to decry the late radical operation, but would urge, rather, that the radical operation be performed early in order to have the cures approximate 80 per cent.

Are there cures for cancer? At present we recognize none other than that obtained by removal from the body by means of knife, cautery, paste, or destructive rays. All methods used to cause a disappearance by absorption within the body by body tissues or fluids are as yet failures as cures, although growths have been checked and even shrunken by such measures.

It must be admitted that there is a wide difference in the malignancy of cancer, in the character of its growth and the tissues involved, yet but little consideration is given to another important point—that there is just as wide a variation in the resistance of the individuals for the same type of cancer. Some patients who have this power of resistance and who remain well for several years after operation are often claimed by the surgeon as examples of the benefits of some particular method of operation or of some unusual care which has been given them. Such patients do well with oft-repeated secondary operations, while others melt away with the disease or through metastasis.

A promising effort is being made to utilize cytolysis by using serums made from patients proved resistant to cancer, and from embryos of the same species, to create a destruction of the cells of embryonic type and character and power of regeneration, as seen in cancer.

Cancer is a disease of adult life. The patient is naturally the one most vitally interested, and he should be informed, in the precancerous stage, of his danger. We lose many opportunities for disseminating life-saving knowledge to the public by a mistaken regard for the sensitive feelings of the patients, until their condition has become practically helpless from an operative standpoint. The layman requires considerable explanation before he can be made to realize that the risk is not in surgery, but in delayed surgery. He considers all operations alike in their danger and severity, while in reality there is a very wide variation. It is a simple operation to remove stones from the gall-bladder. A delayed operation may require their removal from the cystic or even the common duct, and very often a pancreatitis will have developed. On an average, one in thirty of these cases has developed cancer as a local condition around a gall-stone which has chronically irritated some mucous area of the gall-bladder duct. In nearly all of the cases of primary cancer of the gall-bladder and liver ducts gall-stones have been found.

If surgery for cancer is in disrepute to-day, it is partly because too large a proportion of patients are accepted without explanation for operation at a stage when there is no possibility of cure, and when their families, if not themselves, should have been informed of their hopeless condition. If they had been left without operation, they would have served as living examples of the results of delay instead of the unsatisfactory results of ill-advised surgery.

We can, however, say this: that we know nearly or quite as much concerning cancer as we do of other medical and surgical diseases. The danger of local irritation of a chronic character has been underestimated. Our present knowledge of the prophylaxis of cancer indicates that all tumors should have a medical examination and the majority of them a surgical consultation in order that we recognize the precancerous condition, and reduce mortality by prevention.

COMMENCEMENT ADDRESS*

By WILLIAM J. MAYO

It is a pleasure as well as a privilege to welcome the members of the graduating class of Rush College to the medical profession. Yesterday you were students in the University, without personal responsibility and only such cares as may come with a prolonged course of study. To-day you are independent workers in the profession; equal in rank with your teachers who, yesterday, were your superiors, for our profession knows no caste, no distinction, only that which we willingly bestow upon those who have been found worthy.

With this independence of thought and action for you, comes great responsibility. Errors of judgment in student days were made harmless by the care and attention of your teachers. From now on you will have no such check upon your actions, and your mistakes will be costly because they concern the health and happiness, if not the life, of individuals.

You have worked long and faithfully in this venerable school of medicine, which numbers among its alumni many of the brightest and best and most useful members of our profession. From its inception Rush Medical College has been one of the great schools of medicine. Its faculty has always contained eminent men, who were leaders in the medical sciences of their period. This is as true to-day as of any time in the past. The corps of teachers, the laboratories, the hospital facilities, and the clinics, leave little to be desired in the way of educational equipment.

When one considers the years of work in the lecture room, the hospital wards, the clinics, the laboratories, and all of the special branches of training, which you have been so fortunate as to accomplish, and compares it with the amount of training considered necessary in this and other schools twenty-five years ago, it may appear that your equipment has been relatively far beyond that which was given in the previous generation. In place of the high-school certificate and a two years' course in medicine most of you have taken a complete college course, followed by four years in the medical department. Yet each period of training must be judged by a comparison with the standards of learning of the times, and this is true not only in medicine, but of the other sciences as well.

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* Delivered at the Rush Medical College Commencement, June 15, 1910.

In spite of the scanty training and meager advantages afforded the medical student in the past, he was undoubtedly as well equipped, relatively, for the accomplishment of his work as you are, because the sum-total of scientific knowledge in medicine was then comparatively small.

In the twenty-five years which have elapsed since I was a student in college, the science and art of medicine has undergone a transformation in this country which you of the younger generation can scarcely appreciate. The essential facts as regards the etiology of disease have been revealed to us. Hypotheses, supposition, and fancies have been replaced by demonstrated facts. It is a remarkable tribute to the teachers and investigators of that earlier period that by their great earnestness, high probity, and splendid personal characteristics they were able to maintain the standing of the profession upon so high a plane with a foundation so feeble, and to hand down to us, followers along the paths outlined by them, so great and glorious a legacy.

Beyond the known facts of anatomy, chemistry, and the simpler problems in physiology and therapeutics, their equipment was based upon accurate clinical observations. They observed the smallest details with great fidelity, making deductions with a sagacity which, I regret to say, at present seems to be a lost art. As we have become more and more dependent upon the laboratory and special investigations in making our diagnosis, we have gradually lost that faculty of clinical observation which enabled these early clinicians to make an accurate diagnosis in the more common diseases almost with a glance at the patient.

The figure of the family physician as we knew him twenty-five years ago has necessarily passed away. In his earnestness, ripe knowledge, and experience he was learned among his contemporaries. By untiring industry he was able to keep abreast of the times, and he occupied an individual position, seldom asking for consultation or help. His colleagues were armed with the same knowledge, differing only in the interpretation of known facts, rather than possessing new and different ones.

The physician of the old school was a formalist. His dress, habits, and life were distinctive of his profession. Much that he practised and believed to be true we know to have been the unconscious appeal to psycho-therapeutics. His very appearance inspired confidence and his manner suggested relief. These forms and mannerisms were stage properties.

Sectarian medicine differed mainly in that it depended almost entirely upon the psychic appeal. To-day the physician is a business man. The frock-coat and the top-hat have been dismissed to oblivion. The curtain is up and all the scenery exposed to the public eye. The *isms* and *pathies* of sectarian medicine are passing away, and will not return, because they can only exist behind closed curtains, and because the public is no longer so credulous.

These old stage properties were not confined to the medical profession. Other professions suffered from the restricting influences of ignorance, cant, and charlatanism. The people have demanded things *sure*. Man has not been willing to conduct his life along the lines of prevention, but has chosen rather to live as he pleased, and, when overtaken with the results of his indiscretions, demands a guarantee of speedy cure. It has been this attitude of the public toward the medical profession which encouraged the growth of homeopathy, eclecticism, osteopathy, and so-called "Christian science," each of these cults having a small basis in fact and a very large amount of assertion. The idea of the specific nature of the remedies fell in with the natural desire of the human mind—a desire to achieve certainty with the least possible expenditure of effort and without sacrifice.

This same desire for specifics has characterized the demands made upon the theological profession, and as a result we have the various church denominations, all with their specific cures for moral ills and promises of certainty for the future, based upon specific beliefs.

In law the same ideas prevailed, and we have a specific law to cure each ill of the body politic, until we have accumulated upon our statute-books a mass of laws, conflicting, contradictory, and all too often a means of defeating the end which they were supposed to attain.

This narrowness of spirit is passing away and changing conditions in all the learned professions are everywhere manifest. In the theological profession we find a unity of purpose existing, and a general inclination of the various religious bodies toward a unity of church. We hear less and less of specific dogmas and a greater insistence upon actions rather than beliefs.

As to the legal profession: the President of the United States is urging reform in legal procedures, and he is being aided by members of the Supreme Court. Committees of the Bar Association are bringing in resolutions which are unanimously adopted with a view to prevent miscarriage of justice, due to technicalities, delays, and subterfuge.

The medical profession has already made great progress. Within the last five years the number of medical colleges has been reduced at least one-half, and the best of the remainder have become associated with great teaching universities. This change has been a great blessing, as many of the defunct schools were an open scandal, filling the profession with illiterate, ill-prepared men of low ethical standards and often of commercial instincts.

The whole profession is undergoing reorganization and is rapidly becoming a united force. The American Medical Association now represents about 80,000 men, and 2,480 counties, out of something more than 2,800, have organized societies, showing a spirit of unity which was unknown to the previous generation.

As a result of general education and consequent advance in average intelligence, the laity are only a few steps behind the professions in their ability to grasp existing conditions. The demand for specifics with which to cure the troubles of man has been replaced by a better understanding of the problems to be solved.

As we grow in learning, we more justly appreciate our dependence upon each other. The sum-total of medical knowledge is now so great and wide-spreading that it would be futile for one man to attempt to acquire, or for any one man to assume that he has, even a good working knowledge of any large part of the whole. The very necessities of the case are driving practitioners into coöperation. The best interest of the patient is the only interest to be considered, and in order that the sick may have the benefit of advancing knowledge, union of forces is necessary.

The first effort made to meet the situation was in the development of clinical specialties. Man was divided for treatment into parts, as a wagon is divided in the process of manufacture. Each part of man was assigned to those who could devote special attention to their particular portion, giving the benefit of superior skill in treatment. Unlike a wagon, man could not be treated in parts, but only as a whole, and the failure to coördinate the various specialties quickly reduced their number. It became necessary to develop medicine as a coöperative science; the clinician, the specialist, and the laboratory workers uniting for the good of the patient, each assisting in the elucidation of the problem at hand, and each dependent upon the other for support.

Just now evidence of team-work is best seen in large hospitals, in the employment of various laboratories for the examination of the blood, secretions, and excretions, and for radiology, and, of still greater importance, the union of the physician and surgeon, not as an occasional event, but as a part of the daily routine.

The teachers in your own school have ever been leaders in showing the profession how this immense knowledge may be applied to the individual case. Each day you have seen patients present themselves in the clinic and given the benefit of the united learning of laboratory workers and investigation by gifted specialists, and, finally, determination by joint consideration of the physician and surgeon.

You will ask, How are these facilities and advantages to be procured in a small town or in the country? The answer is, *by coöperation.* Every little center must have its laboratory for special examinations. The country physician must be allied with a group of associated workers and no longer thrown upon his own resources. By means of the rural free delivery, telephone, automobile, trolley, and steam-lines, quick communication will aid the new order of things and help make possible such association.

Within the past fifteen years the small hospital has made itself manifest in every community, and little by little these hospitals are becoming centers of influence, although as yet too much confined to the clinical branches. They are, however, a definite nucleus of coördination and coöperation, about which the new order of things may concentrate. The people will demand, the medical profession must supply, adequate means for the proper care of patients, which means that individualism in medicine can no longer exist.

Through custom we have come to look upon the legal profession, in a way, as officers of the government; indeed, their oath makes them such. Their function is a high one, but, after all, is only concerned with property.

In the future the medical profession will also become closely associated with the government, and with a far more important function—that which deals with the life and health of the people. It appears to me that the laity will soon appreciate the necessity of this work, possibly before the medical profession is ready to undertake it.

Our duty in the past has been largely to individuals; in the future the greatest benefits will be rendered through services to the masses. In the past the physician felt his duty to be well fulfilled when saving the life or improving the health of each patient, but when one considers the enormous benefits which will result from the suppression of such diseases as tuberculosis, typhoid fever, yellow fever, etc., it makes these individual efforts look small.

The decline and fall of the Roman Empire is said to have been largely caused by preventable disease; pestilence rather than war. Disease and death from impure water made beer-drinkers of the German nation and wine-drinkers of the French and Italians—by a process of natural selection. To-day pure water-supply for the people is making a Continental temperance movement possible. The Chinese met the problem, not by sanitation, but by developing a pathologic resistance to unhygienic surroundings at the expense of intellectual development, with the result of the survival of those most fit to resist disease. It was the diseases of the white man, not bullets, which settled the Indian question in America.

Colonel Gorgas has made the Panama Canal Zone a white man's country; Reed lost his life that yellow fever might be eliminated from Cuba and our southern States; Ricketts, of your own University, has given his life to the same work.

We are now hearing the word *conservation* used on every hand—conservation of forests, water-power, public lands, and coal; all very important, but only secondary when compared to the importance of conserving the vigor and life of the people.

In sanitation lies the great opportunity of modern medicine: our mission is not merely the art of healing, but the art of preventing disease. The time is ripe for action in the medical profession; the people are ready, we must furnish leadership.

How shall we meet the imperative demand which is before us for the care of public health? By coördinated medical effort; by extension of small beginnings already in existence in each community; beginnings which center about the local health office. The State has at last assumed certain long neglected duties to their citizens in preventing disease by controlling the water- and food-supply, and by other important health measures. The details of carrying out these various reforms can only be properly accomplished under the leadership of members of our profession. Our universities are waking up to this need of service to the public, and are offering under-graduate courses in sanitation. The time will come, shortly, when the graduate will have to be equipped for these duties, and as a result the establishment of departments for training health officers will follow.

Almost without encouragement or public notice, the health officers of the various States and communities are already superintending these matters. Note their methods of effective coöperation in the manner in which they are furnishing an early diagnosis in cases of contagious sickness and in the distribution of antitoxins, vaccines, etc. The consequent saving of the lives of the citizens and the general productiveness for the State is enormous.

In view of the fact that the medical profession must take such an important part in this work of sanitation, the physician should take an interest in politics. There has been a feeling, both within and without the profession, that the physician should not take part in the political issues of the day, and a certain stigma has been attached to the physician who held a State or municipal office. This prejudice has not been confined to the physician, however, and many worthy citizens have avoided political life, thus enabling minority to rule, and too often to its own personal advantage. That our political world has contained the most pernicious elements cannot be denied, but if in the future we all do our duty, the part played by this element will be reduced to a harmless point. In France this duty of the profession to the public has been met manfully: the French parliament includes among its members some of the most talented and scientific of the French physicians.

American physicians should no longer evade their citizenship. Their obligation to the community which has enabled them to acquire their knowledge should be paid in public service.

What must you as individuals do to justify the training you have received? Many of you have received this training through sacrifices of your parents and your families. Certainly you cannot justify their sacrifice in the matter of dollars and cents, as no one in the medical profession can be pointed out as having accumulated great wealth, as estimated by commercial standards. The justification must lie in the devotion to the work and the fulfilment of obligation, not only to the patient, but to the public.

Commencement is in truth what the word implies—a beginning.

Your studies have not ended, but only just begun. The many branches, and the abundance of knowledge concerning each one of them, will force you to cultivate some part of medicine, rather than attempt to cover the whole. Naturally you will gravitate into one of three fundamental branches. Many of you will take up clinical medicine in some of its aspects; others of you will choose the growing field of laboratory work, with all of its possibilities in the way of research; while an increasing number will find employment in public service, poorly paid but rich in opportunities for good to humanity.

It is perhaps trite and commonplace to say—you must work. However, I believe that work and the manner of its accomplishment will make your success or your failure in the years to come.

Cultivate methodic habits of study. Remember that study is a part of your business and must be habitual and daily. I would suggest the plan of reading not less than one hour a day. If, when taking a vacation, or for any other cause you should lose some hours of study, keep a credit and debit ledger; a week means seven hours to make up. Never allow yourself to borrow from the future; not that you should confine yourself to one hour a day, but three or four hours' reading in one day should not be used for credit in advance.

Take frequent vacations from active work, to attend clinics and walk hospital wards. See things for yourself; reading alone is not enough. The Clinical Surgical Association and the Physicians' Interurban Club represent the idea in coördinated form.

Write papers; they will do you much good, although at first they may not benefit any one else. In order to write papers you will institute a wider range of reading and investigation, you will learn to crystallize your thoughts and expressions, and, finally, to produce work worthy of your efforts.

Attend your medical societies and take part in the discussions. The best man in your local society naturally takes a place in the district society; from the district to the State, and from the State to the national organizations.

I would admonish you, above all other considerations, to be honest. I mean honesty in every conception of the word: let it enter into all the details of your work; in the treatment of your patients and in your association with your brother practitioners. Should you have no stronger incentive, be assured that, to be other than fair, generous, and sincere, will ultimately spell ruin and not success. Jealousy in the medical profession is proverbial and it has done more to retard development than all other restricting influences combined.

In conclusion, I wish you a genuine success; not judged by commercial standards, but by the ideals which have ever been held by the long line of worthy men of medicine who have preceded you.

NOTES ON ITALIAN SURGERY

By WILLIAM J. MAYO

The science and art of surgery have no country, and while the practice of the art varies in some particulars with different nations, it may be truthfully said that the best surgery is much alike in all civilized countries. Italian surgery is no exception to this statement. The great surgeons of Italy conduct their clinics much as the clinics are conducted in France, Germany, Great Britian, and America.

In making a direct comparison between the work done in America and that which is done in foreign countries, we cannot flatter ourselves that we are leaders all along the line. Surgeons in other countries are making equal effort and equal progress. Naturally, every country has its peculiarities, and in this little narrative it is my purpose to give my version of the conditions which have contributed to the development of the Italian school of surgery.

One is very apt to think of a holiday in the light of a summer vacation, yet those of us who live in the north and take our vacation in the summer-time, to travel abroad with a crowd of tourists and suffer from heat, dust, and usually from poor accommodations because of overcrowding, often have experiences little resembling a vacation. Moreover, the university clinics are not in operation during the summer semester, and one might get a very poor impression of medical conditions in foreign clinics from a visit paid at that time; but during the spring months the clinics are in full operation, and the leading surgeons are at work.

From the first of June to the first of March, at least nine months,

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the weather conditions in Minnesota bear a favorable comparison with any part of the world it has been my privilege to visit. A popular and fallacious idea, at least as far as Minnesota is concerned, is that the summer months, especially July and August, are not favorable months in which to perform operations. We have found the contrary to be true. No other months in the year furnish a lower mortality or a smaller morbidity, and, as a rule, patients do not suffer particularly from the heat. We are, however, obliged to admit that in March, April, and the first half of May, the weather is apt to be trying, particularly after one has finished a hard winter's work. The latter part of April and the month of May are usually pleasant months in Germany, Austria, France, and in the lower elevations of Switzerland, while Italy offers ideal conditions in March and April. Here one needs warm clothing in the house, but out of doors the sun is bright and warm, and the air soft and fragrant with luxuriant growth of flower and tree. The orange trees are filled with fruit.

For travelers who dread the ocean voyage it will be a comfort to know that large vessels of moderate speed are now in the New York and Mediterranean service. Generally speaking, the larger the vessel, the less the sea motion, and a steamer sailing four hundred miles a day has very little vibration compared with one sailing five hundred or more miles a day.

The first stop en route is usually made at Genoa. By landing there one can reach the principal cities in Italy by short stages, and then sail for home from Naples direct, thereby saving several days' time.

Italy suffered from Continental wars for twelve hundred years and was divided into petty states fighting with each other. It has now been a united Italy since the year 1870. Everywhere one sees statues of Victor Emanuel Second, representing the crown; of Garibaldi, representing the arm; and of Cavour, representing the brains which united Italy; just as William First was the crown, Moltke the arm, and Bismarck the brains which unified Germany.

Remarkable progress will be seen if one has not visited Italy for a decade. The beggars have nearly all disappeared, the people generally appear contented and industrious, and their saving, frugal habits resemble conditions among the French peasantry. It is no longer just to speak of the home of these thirty-two millions of progressive people as "Poor old Italy."

The people of northern Italy make ideal patients. They are cheerful, patient, and obedient, exhibiting many German traits, which might be expected from their previous political associations. The people of southern Italy and Sicily differ widely from those of the north, and it is from that portion of the state that America draws such a large percentage of laborers, and, unfortunately, many great rascals. The inhabitants of northern Italy are in every way a superior people. They are scientific gardeners and intensive farmers, and they would make a very desirable class of permanent emigrants.

In no way does this modern spirit of progress show more prominently than in educational matters. There are four grades of schools, beginning with the elementary and ending with the university course, all controlled by the state. The elementary course is free and compulsory and lasts five years. A pupil usually enters at five years of age, and at ten years of age the industrial life of the individual begins, four years earlier than it begins in this country. Everywhere one sees polite industrious youngsters at work, which adds greatly to the industrial success of the country. This term of education about equals the sixth grade here, but it teaches necessary things much better and is devoid of "frills." From the elementary period on, education is elective and subject to a small fee. The next step is to the gymnasium. This course lasts five years and costs about six dollars a year. Following the gymnasium course comes the lyceum or pre-university course of three years, which costs six dollars a year. This department cannot be entered by the student until he is fourteen years of age, although the gymnasium course can be completed in four years by an exceptionally bright student. The average age at graduation is twenty-five years, the student having had nineteen years of preparation.

For those who are ambitious for position, long, slow work in the clinic and in minor positions is the road to preferment. A university graduate must give at least one year to the army, and men in all other pursuits must give at least two years. At first thought it would appear that two years from the life of every male during the strongest and most productive period would be a great economic loss, but their time is made valuable, as they are occupied in policing the country, and life and property are no longer subjected to danger and loss because of the bandits with whom Italy was infested until recent years. Of even greater importance in this training is the teaching of discipline and respect for constitutional authority, which are so necessary to the political life of a people who have recently passed from feudalism to constitutional freedom.

There are nineteen universities, and it is generally thought that this number is too large for a small country of short distances. This number may be accounted for in the history of Italy, with its many provinces acting independently and too frequently engaged in internecine warfare against neighboring cities. For example, the province of Tuscany has three universities—in Florence, Siena, and Pisa—not over fifty miles apart, but we must remember that Pisa and Siena were at one time large and important cities quite independent of each other. Poor old Pisa! A few hundred years ago the most important maritime city of Italy, it now has but fifty thousand people. It lies four miles from the sea, the river Arno having built up a great flat of land between. It still has its old university, and a good medical department is associated with its hospital.

There are but three universities in Italy which are complete. These are at Turin, Rome, and Naples. The one at Naples is the largest and has over three thousand students; and that at Rome has about two thousand students. All of the professions and all of the branches, including dentistry and veterinary medicine, are taught in these three universities. The other sixteen universities in other parts of the country are more or less incomplete, that is, they are lacking in some of the professional branches, but nearly all of them have a medical department. Therefore we find the same overcrowding of the medical profession which we have elsewhere abroad and in America.

In comparing the Italian and the American plan of education, Italy is not the loser. In the United States, from the time the child enters the first grade, he is harnessed up to a system which ends in the university, and always with the direct intention of fitting him to be President of the United States. The mere fact that only a small percentage of these students ever reach the university or have an opportunity to become the President counts for nothing. Everything in America must be "machine-made," without any possibility of developing individuality. In our country schools nothing is taught concerning farm life, the growth of grain, or anything in the way of agricultural pursuits; neither in the manufacturing districts is there any educational variation with the view to the future employment of the individual. In Italy the first five years in the elementary school teach the things which are necessary for all classes of citizens to know. The Italian elementary course is not top-heavy in mathematics, as it is with us, as, for example, giving to the youngsters in the fourth, fifth, and sixth grades difficult and silly problems and combinations which never occur in commercial life. Not even in the Italian gymnasium course, which lasts five years, is the university the object in view, but rather a good business training. It is not until the student enters the three-year lyceum course that he is actually headed for the university.

ITALIAN HOSPITALS

It is a little difficult to understand the Italian hospital system. If one goes abroad to criticize, there are plenty of opportunities; but why go abroad for that purpose? There are plenty of opportunities at home. The Italian hospitals are mostly old, and little resemble our new modern buildings, but they are clean and well lighted and aired; the care of the patients is the best; the food is good and suitable for the people. Finally, the results are excellent and will bear favorable comparison with the average results in this country. The hospitals are controlled by the state, and the expense is borne by the municipality and the state Nuns are in charge of the nursing in the wards, and they are assisted by untrained female helpers. In the male wards the nursing is done by male orderlies. The hospital wards are very large, usually containing from twenty-five to fifty beds. At the end of each ward there are usually four private rooms, containing one or two beds each, for very sick patients.

The ceilings are high, the floors stone or tiled, and the windows are five or six feet from the floor. The large hospitals are usually connected with medical schools, and these medical schools are among the oldest in the world. The one at Bologna is the oldest, and it was there that anatomy was first taught by Taddeo, Mondina, and Vesalius. At Bologna to-day is the greatest orthopedic clinic in Italy, if not in Europe. In the old University of Padua, Bassini is to be found, whose contributions to the science and art of surgery are so well known. Padua is about fifty miles from Bologna and an equal distance from Venice. Pavia, half an hour's ride from Milan, contains one of the oldest universities, the surgical clinics of which have been made known through the work of the late Bottini and his contributions to literature on the subject of surgery of the prostate. His successor in the University, Golgi, is known to fame through his studies of the nervous system.

Genoa.—Genoa has two large hospitals, one old one and a very beautiful new one, named for its founder, the Duchess Galliers. The hospital is endowed very liberally, and it is charmingly situated on a high hill on the shore of the Mediterranean and facing the city. The front of the building is the shape of a segment of a circle, composed largely of marble, and it has two long galleries or corridors. There are five pavilions for the sick, two and a half stories high, with basements, projecting out from the corridors toward the sea. The kitchens are located in the basement, and the upper story contains rooms for the help. The wards on the first floor are for the medical service, and those on the second floor for the surgical service. The operating-room for septic cases is, however, on the first floor. The main operating-room and a smaller "laparotomy-room" are on the second floor. There are twenty-two beds in each ward, with the usual small rooms at one end for patients requiring special attention, and the service, diet-kitchen, etc., are at the other end. Connected with the hospital is a small well-equipped laboratory building, containing postmortem rooms, museum, etc., in the hands of paid men. The x-ray laboratory is also in the hands of a competent salaried man.

Milan.—Milan is but a few hours' journey from Genoa and is the second largest city in Italy, having somewhat over six hundred thousand inhabitants. Milan is not a university town proper, as the university is situated at Pavia, about a half hour ride by train. The hospital is not only one of the oldest, but it is the largest in Italy, having a capacity of three thousand beds. The main buildings are still in use after over five hundred years of continual service, and old as the buildings are they are still very useful for the purpose. A year ago while traveling in Mexico I was very much interested and impressed with the old hospital at Guadalharja, which was built one hundred and thirteen years ago by a Spanish bishop. I thought at the time that it would be difficult to plan a hospital for a tropical country which would be superior to it. When I saw the plan of these old buildings at Milan, which were originally built for a monastery, I immediately recalled the similarity in design between the two. The hospital is built in the form of a series of crosses connected at the ends, leaving little inclosed courtyards in the center filled with flowering shrubs and trees. In each arm of the cross is a ward containing seventy beds, or two hundred and eighty beds in each cross. The altar, acting as a partial screen between the four wards, is in a glass compartment in the center, and the two hundred and eighty patients are thereby enabled to participate in the religious services. The ceilings in the wards are about thirty feet from the floor. Windows are numerous and begin six or seven feet from the floor, thus giving free circulation of air. Medical patients occupy the old building; surgical, gynecologic, and obstetric patients occupy seven pavilions, which have been built recently. In each of these pavilions there are four wards with a capacity of thirty beds each.

I was fortunate in having met Andrea Majocchi while he was in the United States, about a year ago, looking up data for the hospital authorities to aid them in the completion of a plan for modernizing their old buildings. Majocchi visited France, Germany, Switzerland, Austria, Great Britain, and the United States. He remarked very enthusiastically to me: "As splendid as were the institutions of all the countries, I admired the American hospitals and clinics most." Through his kindness I was enabled to make the best use of my time in the way of medical sight-seeing in Milan.

The accident service in Milan is very large. Rossi showed me a large number of cases of fracture of the femur with results which I have never seen equaled by non-operative measures, that is, taking one case after another. Patients coming to the hospital with fractures of the femur have a light Buck's extension applied with an ice-bag at the seat of the injury for twenty-four or forty-eight hours. At the end of that time the patient is put on a fracture-table, similar to the one I saw Schede using in Bonn, ten years ago. Rossi told me that he had used this table for a model, although he had simplified it greatly. The injured limb is moderately abducted and screw-traction put upon it. While held in this position the foot, ankle, leg, and thigh are amply protected by cotton, and casts are applied, leaving the knee and part of the ankle free. Into this cast two lateral splints are incorporated, jointed at the knee, which continues the extension, but permits motion. A spica plaster-of-Paris bandage incloses the pelvis and is joined to the cast. After three days a radiograph is taken, and if the fracture is not in good apposition, which happens in about 50 per cent. of the cases, the patient is put back in the fracture-frame, but, instead of securing the counter-extension by traction, the limb is slipped through an iron ring, which acts as a collar around the upper end of the cast. The cast is then cut through in a circular manner at the seat of the fracture, which lies just above the ends of the iron splints. Traction is again applied, separating the cut cast until the ends of the fracture are in apposition. The gap is filled with fresh-cotton wadding and plaster-of-Paris, and the ends of the Buck's extension-straps, which have been used for the pressure-traction, are caught into hooks on a little roller in the bottom of the splint. With a high shoe and a pair of crutches patients are permitted to ambulate at once, and in the wards a dozen or more of them were moving about. I saw several cases which were being treated in this manner, and examined the radiographs of their injuries. I realize that my imperfect description of the method will not enable any one to carry out the treatment, but I hope it may call attention to this very excellent method of treating fractures of the femur.

In Crosti's pavilion I witnessed a cranial operation for a tumor which proved to be a glioma. I was interested to note that the surgeon wore cotton gloves over his rubber gloves while operating.

The gynecologic and obstetric pavilion, made famous by the late Porro, whose statue adorns the front of the building, is now under the directorship of Mangagalli, who does a large amount of abdominal work. He wears rubber gloves, etc., as we do in this country.

Venice.—The hospital in Venice, like the one in Milan, dates back to the fourteenth century, and was originally built for a monastery. It has high ceilings and large wards. One ward, which was built for an audience-chamber, contains a hundred and fifty beds. The wards appeared scrupulously clean. On the walls are beautiful paintings by the old masters, and the ancient woodwork is the most decorative I have ever seen. Giordano is the surgical director in this hospital. He is a rapid operator and uses a mask, but no rubber gloves. His assistants wear them, however, but without sleeves. Giordano showed me a number of interesting cases in his wards. He has had several cases of one-sided nephritis treated by decapsulation, with good results. This hospital, with its fine clinical material, is well worth visiting. The building is a quaint old place surrounded on three sides by the sea, with a tide of from two to four feet. The air is constantly fresh, and, as practically all manufacturing establishments in Venice use hand labor, there is no dust or smoke to soil the buildings.

Florence.—The general hospital at Florence (Ospedale di St., Maria Morra) is very old, of the thirteenth century. The only modern parts connected with it are the operating-rooms, which were given by a wealthy American woman who married into the Italian nobility. Burci is the surgical director of this hospital. He was very kind, and I enjoyed the privilege of visiting his wards to see patients after operation. He showed me many interesting cases, especially of tuberculosis and syphilis of the bone.

I spent a good share of one morning with Celso Pellizzari, who is the leading specialist in skin diseases in Italy. He has an enormous amount of material, his apparatus is of the best, and with the aid of a number of assistants he uses the Finsen light, the x-ray, and radium for lupus, epithelioma, etc. He said that the Finsen light is the most useful of all in lupus, but it has no effect on epithelioma. In superficial epithelioma the x-ray is effectual, and radium is the most powerful. He has a large apparatus for the treatment of cancer by *fulguration*, but has not found it of any special value over the older methods.

Rome.—The Polyclinic in Rome is a modern hospital built on the pavilion plan, two stories in height. It occupies a fine position in spacious grounds filled with shrubbery and trees. The hospital has a capacity of twelve hundred beds. The front buildings are used for administration purposes and for university clinics, including the laboratory for special research. Durante, who holds the chair of surgery in the University of Rome, and who is director of the surgical clinic, has eighty beds at his disposal in the hospital. Durante is a man somewhat over sixty years of age and is especially interested in teaching and in experimental research. Many interesting investigations are made in his laboratories.

In addition to these eighty beds for surgical cases there are three surgical pavilions of seventy-four beds each. Bastianelli, who is well known in America, is director of the first pavilion. The second pavilion is under the care of Alessandri, and the third pavilion is under Ferreti. In all, there are nearly four hundred surgical beds, for which ample material is furnished. One or more clinics are held here every morning, giving a splendid opportunity to visiting surgeons. Somewhat over seven hundred operations are performed every year in each of the three pavilions. In the

University clinic six hundred operations are performed, and in the gynecologic clinic five hundred, making a total of about thirty-three hundred operations a year.

Bastianelli has recently introduced, in his pavilion, the first school for training nurses in Italy. English trained nurses are at the head of the school. The operating-rooms in this pavilion are well lighted and the work is conducted in the most modern way. The surgeons wear caps, rubber gloves, and sleeves, and the general aseptic and antiseptic arrangements are splendid and carefully carried out. I had the pleasure of seeing a number of operations performed by Bastianelli and Alessandri at the Polyclinic, and I wish to express my admiration for the high character of their work. My acquaintance with Bastianelli's clinic was much more extensive than with that of the other clinics, and I was greatly interested in what I saw there. Both Bastianelli and Alessandri used spinal anesthesia in preference to any other. In operating about the upper part of the body and head, the patient is put to sleep with chloroform and the anesthetic continued with ether, using a Sudeck inhaler.

As regards spinal anesthesia: Bastianelli has used it in his clinic in more than seventeen hundred cases without a death. He prefers novacocain, and never employs the high injection, to which he is, in fact, very much opposed. The injection is usually made quite low down between the third and fourth lumbar vertebræ. For abdominal operations, 10 c.c. novacocain, in a Merck's tablet, is dissolved in 1 c.c. of sterile water and sterilized over an alcohol lamp. This solution is drawn up into a syringe, which is provided with a strong needle, in order that it may not break and leave a piece in the body. The needle is detached. The patient is placed in a sitting posture bending forward, and the usual lumbar puncture is made with the needle not higher than the second or third lumbar vertebræ. An assistant places his finger parallel with the crest of the ilium as a rapid means of indicating the fourth lumbar spine. When the spinal fluid begins to drip,—sometimes it is necessary to use syringe-suction to start the flow,—the syringe containing the novacocain solution is attached to the needle, and 2 drams of the spinal fluid are drawn into the syringe and allowed to mix with the solution. The contents of the syringe are now forced into the spinal canal, and again the syringe is filled with the mixed fluid in the canal. This is also forced into the canal, and the needle withdrawn. In all the operations I saw, the analgesia was complete. For example, a large ovarian cyst was removed; a nephrolithotomy in a fleshy male, which necessitated the removal of the twelfth rib; a suprapubic prostatectomy; and many other operations. The lower the site of the operation, the more effectual the analgesia, 7 c.c. being ample for any operation on the lower limbs. If the patients exhibit any symptoms of collapse, they are given camphorated oil subcutaneously.

Bastianelli was experimenting with chloroform solution given in the veins as an anesthetic. He prefers chloroform to ether in this method as being less liable to cause embolus. In administering this anesthetic the saphenous vein is exposed in the middle of the thigh, and a cannula is introduced and tied into it. The cannula is connected by rubber tube to an air-pressure bottle containing 2 liters of fluid,—chloroform 0.06 c.c. in 100 grams of salt solution. This solution is slowly forced into the veins by hand-bulb air-pressure on the contents of the bottle. Bastianelli says that not more than 2 liters of the solution should be used, as it overfills the circulation and causes hemorrhage. He says that heart disease and arteriosclerosis are contraindications to its use, and he does not, moreover, advise its use, as the method is at present purely experimental. I witnessed an operation on a male patient with extensive cancer of the mouth and tongue, who was anesthetized in this manner. The case was in a way a desperate one, and the operation was successfully accomplished.

Another very interesting case which I saw in this clinic was the removal of the tongue under local anesthesia. A little novacocain was injected into the tip of the tongue, which was then grasped with vulsella forceps. Novacocain was injected laterally close to the jaw, and in a few moments the whole tongue was removed painlessly with a pair of curved scissors.

His method of preparation of patients for operation is rapid and apparently effectual. The patient is washed and shaved without soap some hours before operation. When brought to the operating table, the field of operation is scrubbed with benzin containing 1 : 1000 iodin. When the skin has dried, it is covered with tincture of iodin, and the patient is ready for operation. Water must not be used, as it causes swelling of the epithelium and prevents penetration of the iodin. The deeper layers of the skin will be penetrated in three minutes. We have used this method of preparation in the clinic at St. Mary's Hospital for several months and can heartily recommend it. Tincture of iodin undergoes chemical changes which render it irritating to the skin, and should not be used when it is more than a week old. We have found 3.5 per cent. tincture efficient. This is one-half the official U. S. P. tincture.

If the rubber gloves worn by Bastianelli or his assistants become soiled during operation, they are washed rapidly in a basin containing alcohol, 2 parts, and tincture of iodin, 1 part. This solution is washed off with sterile water, and the gloves are not changed.

Bastianelli uses silk for sutures and ligatures. The silk is boiled ten minutes in 5 per cent. carbolic acid solution the night before it is used, and again in the morning just before it is used. It is taken directly from the solution.

There were two series of experiments being conducted in the Polyclinic which appeared to me to be of great value. The first was in connection with osteomalacia, a very common disease in Italy, and by no means confined to the parturient state. It is occasionally seen in men. These patients are often bedridden for months or years, acquiring great deformities, which are rendered permanent by the eventual hardening of the bones. Many years ago it was accidentally discovered that removal of the ovaries would sometimes cure the disease. It has now been shown quite definitely that it was not the removal of the ovaries, but the effects of the chloroform anesthesia, which brought about the remarkable cure. These patients are anesthetized once for one-half or three-quarters of an hour, which usually results in a cure. I saw a great many of these cases in the hospital. Arcangeli has been able to cultivate a specific diplococcus from pieces of bone and periosteum, which were removed by a slight operation for the purpose of examination. The material is usually removed from the tibia. Arbom found the same diplococcus in rickets, and Bignami found the same diplococcus in Paget's disease of the bones and joints. They have been able to cultivate and culture this diplococcus and, by injecting it into rats, to produce the characteristic bone-disease. If injected into young rats, up to five days old, it produces typical rickets. If introduced into adult rats, it causes osteomalacia. As a result of these experiments a curative serum has been produced which appears to be efficacious.

The second experiment, and the thing that impressed me more than any other one thing in Italy, was the extraordinary cancer research being conducted by Fischera. It really does appear as though we are in sight of positive knowledge in regard to the disease. Personally, I have never been impressed with the germ theory of the etiology of cancer. It seems to me that up to the present time a modification of Cohnheim's original hypothesis gives the best working theory of tumor-formation. The only thing which we have known positively about carcinoma is the influence of chronic irritation in its production. Chronic irritation causes, normally, an increased production and activity of the epithelial elements, obeying the natural law of compensation; but when this process fails to stop—when compensation is complete and continues to develop and to invade other tissues—we have cancer. An injury causes activity of the connective-tissue cells for the purpose of repair. When this activity fails to stop at the point necessary for repair, and continues riotous production and invasion of the surrounding parts, we have sarcoma. The causation of the condition, then, may lie either in the stimulation which causes it to advance or in a lack of normal ability to check. That it is the cell itself which is diseased is shown by the fact that all secondaries, no matter where situated, reproduce the primary cell, and not merely a cancer of the organ in which it is found; that is, in cancer of the lip with a secondary of the liver, the secondary will be epithelioma.

It follows, then, that the vital point in cancer, both carcinoma and sarcoma, is the rapid, uncalled-for production of embryonic cells. It has been shown that an extract made from a normal organ, when injected into a healthy animal tends to cause the destruction of the same organ. Bolton made an extract from the scrapings of a normal animal's stomach, and this extract when injected into a healthy rabbit caused ulcer of the stomach. Maury showed that an extract of bile-pigments would cause fatty degeneration of the liver. Finally, in the contagious tumors of rats it was found that an extract made from an embryonic rat would cause the tumor to disappear.

The explanation of Fischera's experiments lies in these known facts: As cancer is due to the unlimited production of embryonic cells, an extract from embryonic cells furnishes the necessary check to the production, and the tumor is then removed through normal processes.

Fischera took two- to six-months' human embryos, which were easily obtained in the obstetric pavilion, crushed them up, and put them in a salt solution until they were dissolved by autolysis. This solution was then injected into patients suffering from cancer. Five patients have been cured through this procedure. I saw three of them.

CASE 1.—Carcinoma of the tonsil, cheek, and wall of the pharynx with extensive glandular involvement. The case was examined by Alessandri and a piece of the growth removed for microscopic examination. The condition was considered inoperable, and the patient was turned over to Fischera. After a number of injections a complete cure was the result. I examined the patient and saw the scars in his throat. I also examined photographs and microscopic slides of the tumor.

CASE 2.—Patient with cancer of the rectum, operated upon by Alessandri. Return of the disease *in loco*. Microscopic examination was made, and the condition was pronounced hopeless. The patient was completely cured by injections.

CASE 3.—A woman with a huge carcinoma of the breast; enormously enlarged axillary and subclavian glands; arm swollen; condition inoperable. After a number of injections the glands completely disappeared, the arm became normal in size, and the tumor was reduced to one-fourth of its former dimensions.

It is worthy of notice in these cases that there was extensive glandular involvement, and that this involvement was the first to disappear.

It should be remembered that all of Fischera's cases were examined by competent clinicians—Durante, Bastianelli, and Alessandri; and that pieces of the tumors were removed for microscopic examination.

Fischera is extremely modest and claims but little for his work. He has given his method and his results freely to the profession. While I am not at all convinced that a cure for cancer has been found, I am of the opinion that Fischera's work is philosophic in its reasoning and a distinct step in advance.

A REPORT OF THE SURGICAL CLINIC AT ST. MARY'S HOSPITAL OF ROCHESTER, MINNESOTA, FOR THE MONTH OF JULY, 1910*

By E. H. BECKMAN

Six hundred and fifty-eight patients were operated upon in this month. It would be neither interesting nor instructive to review all of these cases in a report of this kind, as many of them are of minor importance. However, most of the major cases and any of the minor ones of interest will be reviewed.

Cases of the same kind will be grouped together and those of especial interest discussed, and in some instances the case-histories will be given. In others some of the details of the operation will be mentioned in order that the reader may get a better idea of the case. Where autopsy findings throw light upon conditions, they also are mentioned.

Ether given by the open or drop method is the anesthetic used in this clinic. Chloroform is used occasionally, but principally to continue the anesthetic in patients operated upon about the mouth and face where it is not possible to keep the mouth and nose sufficiently covered to give ether.

Operations upon the Head and Neck

Craniotomy.—There were two craniotomies, one of them a decompression operation in a boy nineteen years old for impending blindness due to a cerebellar tumor. He had had symptoms for one-and-a-half years. The other, a man forty-three years of age, had a depressed fracture of the skull in the left frontal region twelve years ago. He had been well until one week before he came for examination, when he had had an epileptic attack lasting three hours. At operation a depressed fracture with several pieces of necrotic bone was found. It would be interesting to know how long the necrosis had been present.

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Carcinoma.—There were ten patients operated upon for cancer of the tongue, lip, and mouth. All were males. In all but two some form of chronic irritation appeared to be one of the etiologic factors in the disease. Six of the ten were heavy smokers, two had bad teeth and one of them a poorly fitted plate, which seemed to be the cause of the irritation. The youngest patient was thirty years of age, the next oldest was forty, and the others ranged up to sixty-eight years.

In four of the patients the cancer was on the lower lip; one of them had been treated with caustics and one for syphilis. Another of the group had had the growth on the lip removed with paste two years previously, and the fourth had had the tumor excised three years before. Both of the latter came on account of enlarged glands in the neck which had been noticed for ten weeks and three months respectively. There was no recurrence of the original growth. Of the remaining six cases, in two the growth was on the tongue, in one in the floor of the mouth, and in three in the alveolar process and cheek.

In each case the content of the anterior triangles of the neck on both sides, including the submaxillary-salivary glands, were removed and the growth itself was excised where it was on the lip, or it was removed with the actual cautery if it was on the tongue or in the mouth.

Tuberculosis.—There were seven patients operated upon for tuberculosis of the cervical glands. The youngest was sixteen, and the oldest thirty-nine years of age. Two were males and the remaining five females. In five the enlarged glands were noticed after the following diseases: cold, measles, whooping-cough, tonsillitis, and la grippe. In one case the glands had been enlarged for fourteen years without suppuration. One patient was operated upon for a so-called mixed tumor of the parotid gland. He was fifty-seven years old and had had a tumor under the ear removed twenty-seven years ago which had been present ten years. The tumor recurred one year after the operation and had continued to grow very slowly up to the present time. He had a facial paralysis resulting either from the former operation or from pressure of the growth. There was a tumor the size of a small lemon in the lower portion of the parotid gland on the left side. The tumor was removed and a block dissection of the left side of the neck made. The pathologists reported the tumor to be an endothelioma.

Diverticulum of the Esophagus.—A female sixty-one years of age gave the following history: Eight years ago she began to notice throat trouble; solid food seemed to stick in her throat. She experienced no trouble with liquids, although ice-water had caused her severe pain for four or five years. She was gradually growing worse and for the past year she had eructations of mucus and ingested fluids. At times a lump which felt like a puff-ball appeared at the suprasternal notch. At the time of examination she had to drink fluids to swallow solid food. A small diverticulum of the esophagus about one inch below the larynx was excised and the esophagus sutured. The wound healed by primary union.

Exophthalmic Goiter.—There were twenty-two patients with exophthalmic goiter, two males and twenty females. Eight of these patients had a portion of the thyroid gland removed (usually the right lobe and isthmus); the other fourteen had both superior thyroid arteries and veins ligated. Operation of ligation of the superior thyroid arteries and veins is performed upon two classes of hyperthyroidism cases: first, beginning cases of a milder degree; it is hoped in these cases that the procedure will produce a cure; second, more advanced severe cases or cases having a more or less acute hyperthyroidism at the time of operation. This simple operation is performed with the hope of relieving some of their hyperthyroidism and thus improving their condition so that a portion of the gland may be removed at a later time with safety.

Five of these patients had secondary hyperthyroidism, having had the enlarged gland from two to sixteen years before symptoms of hyperthyroidism appeared. Four out of this group of five cases were females. The one male patient had a ligation performed, and a portion of the gland was removed later.

Four of the remaining seventeen patients had the right lobe and isthmus of the thyroid gland removed, one of them having had a ligation of the superior thyroid arteries performed at home six months before. The remaining thirteen had a ligation of both superior thyroid arteries and veins.

Simple Goiter.—Thirty patients, all females, were operated upon for simple goiter.

In sixteen a partial thyroidectomy was performed. In fourteen cysts or adenomata were enucleated. One patient thirty-seven years of age had noticed a small tumor in the left lobe of the thyroid gland two years before which had steadily increased in size until at the time of examination it was the size of a hen's small egg. The tumor proved to be a carcinoma entirely confined to the left lobe of the gland.

Breast.—There were ten patients operated upon for carcinoma of the breast. All were married women, the youngest thirty-five and the oldest eighty-five years of age. The growths had been noticed from five weeks up to sixteen years. In three instances a history of injury was obtained; in one case fourteen years before, in another three years. One woman forty years old, with a rapidly growing carcinoma of four months' duration, had had a suppurative mastitis with multiple incisions four years before. In two instances the carcinoma was a malignant degeneration of cysts. The growth in these cases had been present for two and seven years respectively. In one patient with a tumor of six weeks' duration the history showed that her mother had been operated ten years before for cancer of the breast which had not recurred, and that two aunts on her mother's side had cancer of the breast.

In all of these cases the operation was a Halsted amputation, but the closure was by the flap method of Jabez Jackson. In addition to the above cases, there were seven women operated upon for benign tumors of the breast.

OPERATIONS UPON THE GALL-BLADDER AND DUCTS

Cholecystectomies.—There were eleven cholecystectomies. It is the custom in this clinic to remove the gall-bladder when it shows enough evidence of disease to destroy its function, or when stones are crowded into the cystic duct so firmly that their removal will permanently destroy the duct. There were stones in the gall-bladders of seven of these patients. In the remaining four there was so much evidence of total destruction of function of the gall-bladder as the result of cholecystitis that it was removed.

Cholecystostomies.—There were twenty patients on whom a cholecystostomy for stones was performed, and eight with cholecystitis without stones in whom the gall-bladder was drained. Seven of these twenty-eight patients were males and twenty-one were females. In one patient there was a marked empyema of the gall-bladder at the time of operation, and in another a perforation had occurred from the gall-bladder into the duodenum.

Common Duct.—Seven patients were operated upon for stone in the common bile-duct—five females and two males. In two of the cases there were evidences of pancreatitis. In one case the cystic duct was dilated so much that the stones in the common duct could be removed through it without incising the common duct. One female, fifty-nine years of age, had been operated upon here two years and three months before for stones in the common duct. The operation notes show that a probe was passed through the common duct into the duodenum at that time. For a year and ten months she appeared to be well, and then began to have symptoms of common duct obstruction which continued until her second operation. At this operation the common and hepatic ducts were filled with stones and stony material. This is, then, a case of reformation of stones in the common and hepatic ducts.

A woman sixty-one years of age was operated upon two years before in this clinic for a hernia of the small intestine through the mesocolic omentum, and for a large duodenal ulcer. The hernia was reduced, the tear in the mesocolon repaired, and a posterior gastrojejunostomy performed at that time. She remained well until three months before her return, when she began to lose flesh and became extremely jaundiced. At operation a large tumor of the pancreas was discovered which was obstructing the common duct. The gall-bladder was enormously distended. A cholecystojejunostomy was performed. The patient died the day following. Autopsy showed the tumor to be a carcinoma of the pancreas.

OPERATIONS UPON THE STOMACH AND INTESTINES

Ulcer of the Duodenum.—There are seventeen patients operated upon for ulcer of the duodenum, four females and thirteen males. All of these patients gave histories of attacks of stomach trouble with intervals of freedom from symptoms. The average duration of the stomach symptoms was twelve and one-half years. A posterior gastrojejunostomy was performed in twelve cases. In seven the ulcer was covered with mattress sutures of linen in addition to the gastrojejunostomy. Perforation had occurred in five of the cases. In two cases pyloroplasty was performed, also cholecystostomy, in one instance for stones and in the other for cholecystitis.

Ulcer of the Stomach.—There were three patients with ulcer of the stomach operated upon. In each case the ulcer was excised and the opening closed by a plastic operation. One of these patients had gall-stones, which were removed.

Cancer of the Stomach.—There were three patients with cancer of the stomach in whom a resection of the stomach was performed. Two others had carcinoma of the stomach; one at the cardia, for which a gastrostomy was performed; in the other the carcinoma was found too extensive for removal. Another patient with symptoms of duodenal ulcer was found to have a moderate obstruction at the pylorus from adhesions of unknown origin. The adhesions were separated.

Intestines.—There were eight operations upon the intestines; four of these were resections—three for carcinoma and one for tuberculosis. One patient fifty-four years old had a carcinoma in the transverse colon which had produced symptoms for nine months, during which time he had lost 30 pounds in weight. Six inches of the colon were resected. Another male, forty years old, had had symptoms for eight months with a tumor in the region of the cecum for one month. He had lost 50 pounds in weight. A carcinoma of the cecum was found, the cecum and 6 inches of the ileum were resected, and a lateral anastomosis made. The third carcinoma was in a man seventy-three years old, who had had an appendectomy for acute appendicitis a year previously. He felt well for about one month, when he began to have pain in the right side, not localized. Three months after the operation he had an acute obstruction, for which an operation was performed. The operator found that adhesions from his appendectomy had caused the obstruction. After the second operation he had further attacks resembling obstruction, and had to keep the bowels loose to get a movement. There had been no blood in the stool. He lost 20 pounds in weight. The third operation revealed a carcinoma of the hepatic flexure and many adhesions about the cecum from his former operations. The cecum, ascending colon, and hepatic flexure, along with 8 inches of the ileum, were resected and a lateral anastomosis made between the ileum and transverse colon. The patient died of nephritis and bronchopneumonia.

The case of tuberculosis is interesting because an operation had been performed elsewhere three months before for suspected tuberculosis, but none was found and an appendectomy was done. The second operation revealed tuberculosis of a coil of the ileum near the cecum. This loop, 6 inches in length, was resected.

A man sixty-two years of age had been struck in the right side of the abdomen with a pitchfork handle nine months before. He was sick at that time for five weeks with a peritonitis, and now suffered from tenderness in the abdomen and attacks of obstruction. There was an indefinite thickening in the right iliac fossa. It was found that he had had a rupture of the ileum about 8 inches from the cecum which was closed by adhesions to the omentum and the wall of the abdomen. The opening was sutured, the appendix removed, and the extensive adhesions separated.

A colostomy was done in a baby one day old for imperforate anus.

There were two carcinomata of the rectum operated upon: One in a man of fifty-four who had had symptoms for one and one-half years. A modified Kraske operation was performed. The other, a man sixty-one, had had trouble for five months. The Harrison Cripps operation was performed.

Herniotomies.—There were thirty-seven patients with hernia operated upon.

Umbilical: One female was operated upon who had an umbilical hernia the size of a fist. She also had gall-stones, which were removed.

Femoral: Two females and one male were operated upon for femoral hernia.

Ventral: One female with a postoperative ventral hernia following a pelvic abscess, operated upon in this clinic three years before, was operated upon.

Inguinal: There were thirty-two males with inguinal hernia; ten double, one of them complicated with double undescended testicles. Of the remaining twenty-two, nine were on the left side and thirteen on the right. One patient had also an epigastric hernia which had recurred after two operations done elsewhere. Another patient had a large mass of paraffin lying near the internal ring which had been injected nine months before for the purpose of curing hernia.

Appendectomies.—One hundred and seven patients were operated upon for disease of the appendix; forty-one for chronic appendicitis, or in the interval. Fecal concretions were found in ten of these forty-one appendices. Fifty patients were operated upon for acute or subacute appendicitis. In six instances there was an abscess outside the appendix. Ten of the entire number required drainage. In addition to these, thirty-seven appendices were removed secondarily in the course of other operations.

OPERATIONS UPON THE UTERUS AND ADNEXA

Abdominal Hysterectomies.—There were twenty-two women upon whom abdominal hysterectomy was performed. Twenty of them were married. Seventeen of the operations were performed on account of fibroid tumors in the uterus. Eight of the women had borne children; the other nine had never been pregnant. Three of the cases of fibroid were complicated by double infection in the tubes. Two others had cysts in one of the ovaries, and another of the patients had gall-stones, which were removed. Of the five remaining cases, three had a severe infection in the pelvis which had involved the uterus. One had a carcinoma of the body of the uterus, and the other, a woman forty years of age, had no children, but had had many miscarriages and profuse menstruation for years. The flow had been so profuse for several months that she was extremely anemic. She had a very thick bicornuate uterus with a much hypertrophied endometrium.

Myomectomies.—There were seven patients on whom an abdominal myomectomy was performed. In two of these there was a retroversion of the uterus, which was corrected. In one there was a dermoid cyst in one ovary, and in another a double inflammatory condition of both tubes which necessitated their removal.

Extrauterine Pregnancy.—Four patients were operated upon for ruptured tubal pregnancy. Three of them were married women and none of them had ever had children. Two of them had fibroids of the uterus; one so large that a hysterectomy was required. The fourth patient was a small, undeveloped girl, fifteen years of age, in whom menses had started one year before. She gave a history of moderate pain in the right inguinal fossa eight days before, with nausea. The next day she felt better. Three days later she again had pain, which lasted one hour. She vomited, was tender on the right side low down, and felt soreness on walking. There was no temperature. Twelve hours before coming for examination she again had pain lasting several hours. She was flowing at the time of examination and a mass could be felt low down in the pelvis on the right side. On account of the patient's age and childish appearance a tubal pregnancy was not suspected, and it was thought that she had an appendiceal abscess. Operation revealed many clots in the abdomen and a highly dilated unruptured Fallopian tube from which the blood was flowing.

Prolapse of the Uterus.—Seven patients were operated upon for prolapse of the uterus. A vaginal hysterectomy was performed in two cases, the Watkins-Wertheim operation was performed on three, and the remaining two patients had a high amputation of the cervix, an Alexander operation, and a perineorrhaphy.

Ovaries and Tubes.—Twelve patients were operated upon for diseases of the ovaries or tubes or both. Four of these had double pyosalpinx. One had inflammatory disease on one side only. One patient had a corpus-luteum cyst on the right side. Another had had a hysterectomy with the removal of one ovary three years before; she was operated upon for a parovarian cyst on the side of the remaining ovary. One patient had a pelvic abscess which drained through the vagina. The left ovary and tube, which were in the abscess cavity, were removed through the vaginal incision. Two patients were operated upon for adherent retroversion of the uterus. The Baldy-Webster method of shortening the round ligaments was used in each case. Another patient, with a movable retroversion, had an Alexander operation, and the perineum repaired.

OPERATIONS UPON THE KIDNEY, BLADDER, AND PROSTATE

Kidney.—There were five nephrectomies for tuberculosis—one female and four males. In going over the histories one is surprised at their uniformity. The common symptom is frequency of urination and bladder irritability, with little or no colic or pain in the kidney. The patients were all between the ages of twenty-one and thirty. There were five nephrectomies for pyonephrosis with stones. These patients were from thirty-eight to fifty years of age. One of them had had a stone removed from the same kidney fifteen months before elsewhere. One nephrectomy was performed in a woman seventy-two years of age for an infected hydronephrosis. There was one nephrectomy for traumatic rupture of the kidney.

The patient, a man thirty-three years of age, had been crushed between the wheel and body of a carriage sixteen days previously. He had passed bloody urine, and two days before operation he had a chill and a temperature of 102° F. At operation many clots were found in the ruptured kidney. A girl sixteen years of age, with a history of pain in the left kidney but no bladder symptoms, had a tumor which was noticed seventeen months previously. It had gradually grown until at the time of operation the mass filled the entire abdomen. The tumor (a sarcoma) was fully as large as a pregnant uterus at full term. A nephrectomy was performed and the patient made a good recovery.

Prostate Gland and Bladder.—There were ten prostatectomies. Nine were done through the perineum, and one, which had been drained six weeks before at his home with a suprapubic drain, was done by the suprapubic route. The youngest patient was sixty and the oldest seventy-five; average age, sixty-five plus. One man sixty-seven years of age had had the middle lobe removed one and one-half years ago at his home, and had been compelled to use the catheter ever since. Another patient, sixty years of age, had had a prostatectomy done at home five years previously, and now had partial obstruction from scar and remnants of the prostate. A third patient, sixty-eight years of age, had had a stone removed from the left kidney six years before. The kidney was now functionating normally. Two patients had carcinoma of the prostate; one, sixty-seven years of age, had used a catheter entirely for three months, and the other, seventy-four years of age, continuously for one and a half years. This patient died of nephritis. In addition to these, three other patients had bladder operations. A man of forty-eight had a suprapubic cystostomy for stones. A patient sixty-two years of age had a suprapubic drain inserted for retention from an enlarged prostate. He has since had his prostate gland removed. Another patient, sixty years of age, who had been passing blood for two years, was explored and found to have an extensive carcinoma of the bladder.

PULMONARY AND CIRCULATORY COMPLICATIONS FOLLOWING SURGICAL OPERATIONS*

BY E. H. BECKMAN

In order to get a proper idea of the frequency of complications that occur after surgical operations, it is necessary to have a considerable number of consecutive cases. This report is based upon 3,657 consecutive cases operated upon at St. Mary's Hospital during the first eight months of the year 1910. The number is composed entirely of hospital cases, and does not include several hundred patients operated upon for minor ailments which did not require them to remain in the hospital.

For convenience, the pulmonary complications will be discussed under three headings—pleurisy, bronchitis, and pneumonia—and the circulatory complications under phlebitis and embolism. Although the pulmonary complications are much more frequent than the circulatory, the mortality-rate is almost the same, six deaths occurring from pulmonary and six from circulatory complications.

Pulmonary Complications.—Ether was used as an anesthetic, although cocain as a local anesthetic has been used in a few cases. It is impossible to say just what beaiing the anesthetic has upon the production of pulmonary complications. A pulmonary complication cannot be justly attributed to an anesthetic until it is possible to exclude the insufflation of material from the upper air-passages, sepsis, and septic emboli.

There were 37 cases of lung complications in the series of 3,657 cases, which means that 1 patient out of every 99, or 0.01 per cent., had some form of lung complication. It should be remembered that a large majority of these cases were extremely mild. There were 6 deaths in this group of 37 cases, a mortality of 0.0016 per cent.

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*Read before the Minnesota State Medical Assoc., Oct. 5, 1910.

Pleurisy.—There were 15 cases of pleurisy—1 case out of every 243 patients operated upon, a percentage of 0.0041. Most of these cases were extremely mild, often not more than a "stitch in the side," and many of them had no rise in temperature. Two of them had an effusion which required aspiration, and one (a splenectomy) resulted fatally. Three of the patients had tuberculosis, although the lungs were not enough affected to produce physical signs of the disease. Two of the patients had carcinoma. Nine of the 15 were abdominal operations. In 11 of the cases the symptoms occurred in the first week, and four in the second week.

Bronchitis.—There were 12 cases of bronchitis, none of them fatal. All of these cases were of a mild type and subsided in a few days. Some of them had considerable expectoration; others were not much more than a congestion, which soon subsided. All of these cases, with the exception of one which began on the ninth day, occurred the first five days following operations. All of them, with the exception of two inguinal herniæ, were abdominal operations—6 of the stomach, 3 of the gall-bladder, and 1 appendectomy and shortening of the round ligaments.

Pneumonia.—There were 10 cases of lobar pneumonia, 5 of which were fatal. Two of the fatal cases were in young adults who had had comparatively simple operations—one a hernia, and the other a tuberculous synovitis of the wrist. Both developed delirium tremens, and died with a complicating lobar pneumonia. The other three cases were debilitated old men with arteriosclerosis. One of them was sixty-nine years old, operated upon for carcinoma of the lip and glands; another, eighty years old, operated upon for stone in the bladder; and the third, sixty-three years old, operated upon for gall-stones, had carcinoma in the tail of the pancreas. Of the five cases which recovered, one was an exophthalmic goiter, for which a ligation of both superior thyroid arteries was performed. The anesthetic in this instance was cocain. Two of the patients had inguinal herniæ; one had the appendix removed secondarily, the other an operation for hypospadias. The fourth in this group had double pus-tubes, and the fifth had gall-stones and also a tuberculous peritonitis. It will thus be noted that of the five fatal cases, two had delirium tremens, and three were old men, sixty-three, sixty-nine, and eighty years of age, two of them having cancer. Of the five patients who recovered, one had tuberculosis, one a considerable infection in the pelvis, and a third was operated upon under cocain.

Circulatory Complications.—There were 23 cases of complications related to the circulatory; 17 of phlebitis and 6 of embolism—1 out of every 159 cases, a percentage of 0.0062.

Schachtler states that in embolism the temperature remains normal, but the pulse gradually increases until the onset of the lung symptoms. Our cases do not agree with this statement, as the pulse was practically normal in every case until the embolism occurred, although the temperature varied. Various authors give the percentage of pulmonary embolism following thrombosis as from 20 to 60 per cent. (Quenstedt, 20 per cent.; Albanus, 43 per cent.; Lubarsch, 59 per cent.; Virchow, 60 per cent.). In this series it was 5 per cent.

The statement is made in the Lexer-Bevan "Surgery," that the most frequent site of the smaller emboli is in the lower lobe of the right lung. In the case which recovered, in our series, the symptoms all referred to this area.

Thompson and Bartlett state that pulmonary embolism occurs oftener in the second to the fourth week. Our cases all occurred the first nine days.

Phlebitis.—There were 17 cases of phlebitis. Three occurred on the right side and 13 on the left side. This makes one case of phlebitis in every 215 operated cases, or 0.0037 per cent. In only one of the right-sided cases (an abscess appendix) can the operation be considered as limited to the right side of the body. Thirteen of the 17 cases followed after abdominal operations and 4 were extra-abdominal. Five were infected cases—2 at the time of operation and 3 mild wound-infections which developed later. In each instance the infection and the phlebitis appeared at about the same time. The individual cases are as follows:

Abscess appendixes	2
Appendix and ovarian cyst	1
Double inguinal herniæ	2
Left inguinal hernia	1
Ovarian cyst	1
Double varicose veins	1
Perineal prostatectomies	2
Abdominal hysterectomies	5
Gastrectomy	1
Perineum	1

Two of these patients had malignant disease—the gastrectomy case and one of the hysterectomies.

The days upon which the phlebitis appeared are as follows:

Eighth day	3 cases
Ninth day	2 "
Tenth day	4 "
Twelfth day	4 "
Thirteenth day	2 "
Fourteenth day	2 "

It will be noted that all of the cases appeared in the second week.

Embolism.—There were 6 cases of embolism; two were cerebral, both fatal. Four were pulmonary; one recovered, three died. In our series there was, therefore, 1 case of embolism in every 609 cases, and there was 1 fatality in every 731 cases. One case occurred on the day of operation, one fifty-six hours following operation, two on the eighth day, and two on the ninth days following operation. In only one case was there evidence of infection either at the time of operation or at autopsy. In one case there was a phlebitis with thrombosis of the left femoral vein. This is the only case which has occurred in several years in this clinic, where there was embolism when a phlebitis was known to be present. The ages of the six patients were thirty-five, forty-three, forty-five, forty-five, fifty-seven, and sixty years respectively.

Case I.—Male, aged thirty-five; no previous disease; for two years mild attacks of abdominal colic; seven days before operation had sudden, severe abdominal colic, which later localized at appendix with formation of tumor. The abscess was drained, no attempt being made to remove the appendix. The temperature at the time of operation was 103°, pulse 120. The morning following the operation the temperature was 99°, pulse 100, and they remained practically at these points until the patient's death, which was instantaneous, and occurred fifty-six hours after the operation. The patient was seen five minutes before his death by one of the house-officers. He said he felt well and had no pain. Autopsy revealed a large abscess in the right iliac fossa, entirely walled off from the remainder of the abdomen. The right pulmonary artery contained a large clot.

Case II.—Male, aged fifty-seven years. Three years before he began having stomach distress after eating, with belching of gas and some vomiting, which relieved the pain. These attacks gradually became worse, and he had lost 43 pounds during the last year. Malignancy was suspected before operation. There was a small umbilical hernia. Operation revealed a Meckel's diverticulum about 3 feet above the ileocecal valve, which was inverted and caused intussusception at its base. The diverticulum was removed. Seven hours after the operation the patient became drowsy, had difficulty in talking, and had a paralysis of his left arm and leg. He died twelve hours after the operation. Autopsy disclosed a clot in the middle cerebral artery on the right side. There were a slight arteriosclerosis and some vegetations on the heart-valves.

Case III.—Female, aged forty-five years. Married; mother of three children; complains of pain in pelvis when on feet; some dyspnea upon exertion; heart negative; trace of albumin in the urine, and a few hyaline casts.

Operation: hysterectomy for fibroids. Lipoma of left breast removed. The patient appeared to be doing well except that she had a temperature between 99° and 102°, which lasted until her death. There was a mild phlebitis of the left femoral vein with some swelling of the thigh for two days. She died instantly on the ninth day. Autopsy was performed some hours after the body had been injected. The abdomen was negative. No clots could be discovered after a thorough search except in the left femoral vein.

Case IV.—Female, aged forty-three years; married; one child, thirteen years old. The patient came because of severe uterine hemorrhage, which had lasted seven weeks. She was anemic and weak from loss of blood.

Operation: abdominal hysterectomy. The patient had a double uterus. She made a good recovery from the operation.

Her temperature did not go above 100° after the second day, and the pulse was never above 90. On the eighth day she complained of feeling weak; had sudden dyspnea and rapid pulse; and died within an hour. An examination through the operation-wound only, was permitted. The abdomen was negative.

CASE V.—Female, aged forty-five years; married; mother of four children; typhoid at eleven years of age; gall-stone colic for eighteen years.

Operation: appendectomy; cholecystostomy for stones. She had an uneventful recovery up to the ninth day. The temperature normal after the third day, with pulse ranging from 80 to 100. On the ninth day she had sudden pain all over the chest. There was marked dyspnea. The temperature became subnormal; the pulse 140, and weak. The patient looked about to die, but she gradually though slowly improved. There was an area of dullness in the lower lobe of the right lung, and she was not free from pain in this region for three weeks. She had several periods, lasting from two to three days, when the pain in the lung became severe, the temperature would rise, and she would cough up blood streaked with mucus. These attacks were attributed to a breaking-down of the tissue in the infarcted area of the lung. There was no effusion into the pleural cavity at any time. The patient was well three months after the operation.

CASE VI.—Male, aged sixty years. Arteriosclerosis. Frequency for two years. Acute retention three weeks before operation.

Operation: perineal prostatectomy. Patient had normal temperature and pulse after the third day. On the eighth day he had increasing dyspnea and a rapid pulse. He died twenty-four hours after the onset of symptoms. A pulmonary embolism was found at autopsy.

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